Oracle Cloud Infrastructure

Oracle Norway Hands on labs

V2.0

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By
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1. Disclaimer

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Overview

Lab Overview

The lab exercises are designed to complement your training, reinforcing the key concepts by applying and demonstrating what you learned in the presentation sessions. This lab book is comprised of individual exercises. These exercises allow you to get first hands-on exposure working with the Oracle OCI Infrastructure Cloud, where you will see how key features and functionality are deployed in the software. Using what you learn in the presentations and individual exercises working with the software, you will collaborate as a team in developing and delivering practice presentations.

Build the infrastructure with Terraform

Terraform runs on a two environment configuration, one Linux (or windows) server hosting Terraform and the build scripts and a target environment on Bare Metal Compute Cloud Service.

The scripts will create a complete OCI environment with Virtual Cloud Network, firewall and Linux Hosts with SSH keys.

In the Lab we will run two different terraform scripts, one simple and one more complex.

Prior to running the Lab you need to get the following key information from your OCI environment:

- **Tenancy OCID**: This is at the bottom of every page in the cloud UI
- **User OCID**: This is on the user page, click copy to copy it straight from the webpage
- **Fingerprint**: Use the fingerprint from cloud UI
- **Compartment OCID**: Go to identity->compartments, then find your compartment. Click copy

Download latest version of terraform, **that is supported by the OCI provider,** at creation time of this lab, it was version 0.10.8, despite latest terraform release at the creation time of the lab was 0.11.5

https://releases.hashicorp.com/terraform/0.10.8/

The labs zip files are provider by the lecturer.

In the examples below, terraform is run form a opc linux account on OEL 6.9, with UEK 4.

Make sure wget and unzip is available, and the kernel is updated.

In case these steps are required:

```
yum update -y
yum install wget -y
yum install zip -y
yum install unzip -y
```

Download and unzip terraform binaries. Verify the readme from https://github.com/oracle/terraform-provider-oci to confirm latest supported version of terraform for the OCI provider. As of writing of this lab, 0.10.8 is the latest supported version.

Commands are:

```
wget https://releases.hashicorp.com/terraform/0.10.8/terraform_0.10.8_linux_amd64.zip

mkdir terraform

cd terraform

unzip ../terraform_0.10.8_linux_amd64.zip
```

```
[oracle@iostf-orakey ~]$ wget
https://releases.hashicorp.com/terraform/0.10.8/terraform 0.10.8 linux amd64.zip
--2018-04-03 10:15:27--
https://releases.hashicorp.com/terraform/0.10.8/terraform_0.10.8_linux_amd64.zip
Resolving releases.hashicorp.com (releases.hashicorp.com)... 151.101.201.183, 2a04:4e42:2f::439
Connecting to releases.hashicorp.com (releases.hashicorp.com)|151.101.201.183|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 14485524 (14M) [application/zip]
Saving to: 'terraform 0.10.8 linux amd64.zip'

100%[=============================================================================================>]
14,485,524  --.-K/s   in 0.06s

2018-04-03 10:15:27 (242 MB/s) - 'terraform 0.10.8 linux amd64.zip' saved [14485524/14485524]

[oracle@iostf-orakey ~]$ mkdir terraform
[oracle@iostf-orakey ~]$ cd terraform
[oracle@iostf-orakey terraform]$ unzip ../terraform 0.10.8 linux amd64.zip
Archive:  ../terraform 0.10.8 linux amd64.zip
  inflating: terraform
```

Download and install Oracle OCI terraform provider from git,

https://github.com/oracle/terraform-provider-oci/releases

Commands (from terraform directory)

```
wget https://github.com/oracle/terraform-provider-oci/releases/download/v2.1.3/linux_amd64.tar.gz
```

Install the OCI provider in the directory .terraform.d under $HOME

```
cd $HOME

wget https://github.com/oracle/terraform-provider-oci/releases/download/v2.1.3/linux_amd64.tar.gz

mkdir .terraform.d

mkdir .terraform.d/plugins

cd .terraform.d/plugins

gunzip ../../linux_amd64.tar.gz

tar -xvf ../../linux_amd64.tar
```

```
[oracle@iostf-orakey ~]$ cd
[oracle@iostf-orakey ~]$ [oracle@iostf-orakey ~]$ wget https://github.com/oracle/terraform-provider-
oci/releases/download/v2.1.3/linux_amd64.tar.gz
--2018-04-03 10:30:14--  https://github.com/oracle/terraform-provider-
oci/releases/download/v2.1.3/linux_amd64.tar.gz
Resolving github.com (github.com)... 192.30.253.112, 192.30.253.113
Connecting to github.com (github.com)|192.30.253.112|:443... connected.
HTTP request sent, awaiting response... 302 Found
Location: https://github-production-release-asset-2e65be.s3.amazonaws.com/72815297/c14bf456-3349-11e8-
80d6-a8d01cea06b8?X-Amz-Algorithm=AWS4-HMAC-SHA256&X-Amz-
```

```
Credential=AKIAIWNJYAX4CSVEH53A%2F20180403%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-
Date=20180403T103015Z&X-Amz-Expires=300&X-Amz-
Signature=7c67ae8c6233907941602368e90c919b740f7feffab2372a4771118b78a10150&X-Amz-
SignedHeaders=host&actor_id=0&response-content-
disposition=attachment%3B%20filename%3Dlinux_amd64.tar.gz&response-content-type=application%2Foctet-
stream [following]
--2018-04-03 10:30:15--  https://github-production-release-asset-
2e65be.s3.amazonaws.com/72815297/c14bf456-3349-11e8-80d6-a8d01cea06b8?X-Amz-Algorithm=AWS4-HMAC-
SHA256&X-Amz-Credential=AKIAIWNJYAX4CSVEH53A%2F20180403%2Fus-east-1%2Fs3%2Faws4_request&X-Amz-
Date=20180403T103015Z&X-Amz-Expires=300&X-Amz-
Signature=7c67ae8c6233907941602368e90c919b740f7feffab2372a4771118b78a10150&X-Amz-
SignedHeaders=host&actor_id=0&response-content-
disposition=attachment%3B%20filename%3Dlinux_amd64.tar.gz&response-content-type=application%2Foctet-
stream
Resolving github-production-release-asset-2e65be.s3.amazonaws.com (github-production-release-asset-
2e65be.s3.amazonaws.com)... 52.216.65.248
Connecting to github-production-release-asset-2e65be.s3.amazonaws.com (github-production-release-asset-
2e65be.s3.amazonaws.com)|52.216.65.248|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 6175320 (5.9M) [application/octet-stream]
Saving to: 'linux amd64.tar.gz'

100%[=============================================================================================>]
6,175,320   --.-K/s   in 0.1s

2018-04-03 10:30:15 (50.1 MB/s) - 'linux amd64.tar.gz' saved [6175320/6175320]

[oracle@iostf-orakey ~]$ mkdir .terraform.d
[oracle@iostf-orakey ~]$ mkdir .terraform.d/plugins
[oracle@iostf-orakey ~]$ cd .terraform.d/plugins
[oracle@iostf-orakey plugins]$ gunzip ../../linux amd64.tar.gz
[oracle@iostf-orakeyv plugins]$ ls -l
total 0
[oracle@iostf-orakey plugins]$ tar -xvf ../../linux_amd64.tar
linux_amd64/
linux_amd64/terraform-provider-oci_v2.1.3
```

Verify the provider location:

```
[oracle@iostf-orakey ~]$ ls -l /home/oracle/.terraform.d/plugins/linux_amd64/terraform-provider-
oci v2.1.3
-rwxr-xr-x. 1 oracle dba 25460920 Mar 29 18:53 /home/oracle/.terraform.d/plugins/linux amd64/terraform-
provider-oci v2.1.3
[oracle@iostf-orakey ~]$
```

Create the .terraformrc with this content:

providers {

oci = "<path_to_provider_binary/terraform-provider-oci>"

}

In our lab it would be: (the correct provider is copied, refer to the cp command above)

```
[oracle@iostf-orakey ~]$ cat .terraformrc
providers {
  oci = "/home/oracle/.terraform.d/providers/linux amd64/
terraform-provider-oci_v2.1.3"
  }
```

Download the script bundle for the oci lab details provided by your instructor

Unip the bundle with: unzip terraform_workshop.zip

```
[oracle@iostf-orakey ~]$ tar -xvf workshop.tar
workshop/
workshop/bash profile
workshop/tf.env
workshop/infrastructure/
workshop/vcn/
```

The infrastructure created (the vm's) need a private/public key par. The public key will be used when the OCI vm's are created.

Generate keys for communication with OCI

https://docs.us-phoenix-1.oraclecloud.com/Content/API/Concepts/apisigningkey.htm

The commands are:

```
cd /home/oracle/workshop

mkdir ~/.oracleoci

openssl genrsa -out ~/.oracleoci/oci_api_key.pem 2048

chmod go-r ~/.oracleoci/oci_api_key.pem

openssl rsa -pubout -in ~/.oracleoci/oci_api_key.pem -out ~/.oracleoci/oci_api_key_public.pem

openssl rsa -pubout -outform DER -in ~/.oracleoci/oci_api_key.pem | openssl md5 -c
```

```
[oracle@iostf-orakey ~]$ cd workshop/
[oracle@iostf-orakey workshop]$ mkdir ~/.oracleoci
[oracle@iostf-orakey workshop]$ openssl genrsa -out ~/.oracleoci/oci_api_key.pem 2048
Generating RSA private key, 2048 bit long modulus
.+++
.......................+++
e is 65537 (0x10001)
[oracle@iostf-orakey workshop]$ chmod go-r ~/.oracleoci/oci api key.pem
[oracle@iostf-orakey workshop]$ openssl rsa -pubout -in ~/.oracleoci/oci_api_key.pem -out
~/.oracleoci/oci api key public.pem
writing RSA key
[oracle@iostf-orakey workshop]$ openssl rsa -pubout -outform DER -in ~/.oracleoci/oci api key.pem |
openssl md5 -c
writing RSA key
(stdin)= 2d:60:73:47:2d:e5:30:9b:db:b6:cf:1e:34:9f:77:f1
```

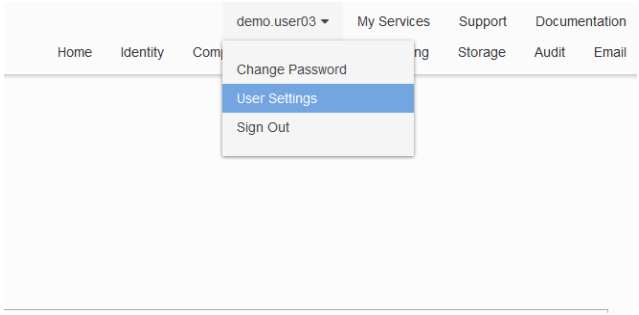
Generate the public key in OpenSSH RSA format:

```
ssh-keygen -y -f ~/.oracleoci/oci_api_key.pem >~/.oracleoci/oci_api_key_pub.ssh
```

```
[oracle@iostf-orakey workshop]$ ssh-keygen -y -f ~/.oracleoci/oci api key.pem
>~/.oracleoci/oci api key pub.ssh
```

The public key needs to be uploaded to your OCI account.

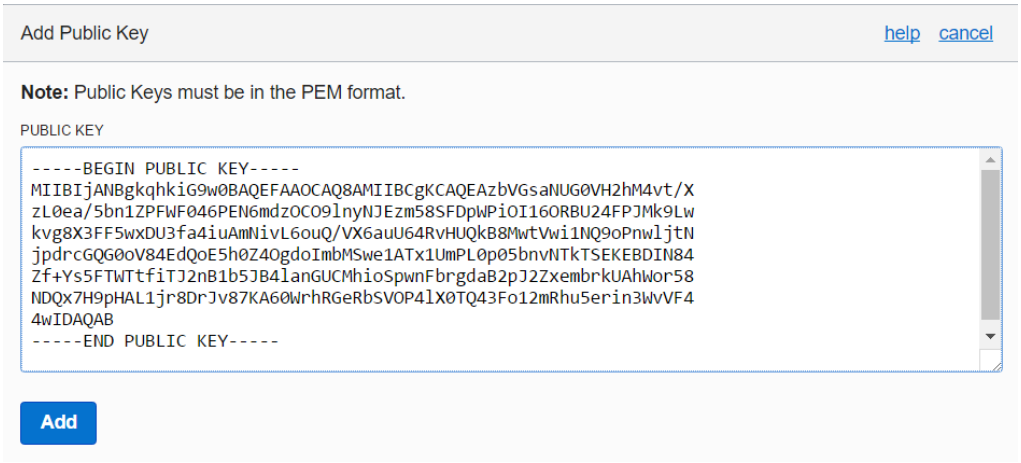
Upload public key to the cloud UI. Go to User Settings



Click on Add Public Key. Add the key from ~/.oracleoci/oci_api_key_public.pem

```
[oracle@iostf-orakey workshop]$ cat ~/.oracleoci/oci api key public.pem
-----BEGIN PUBLIC KEY-----
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAsB56vBe9IZ3qYJwgKM7K
lGScSdnc8MRMGe5BP/ztQLif9MNHM1l83do2Uph+BYjBG95C5Etwzv7qH0aCnO5s
cBh0EXJFvFPFem8tFI1e7lPtBUY1JbyUpfU2ivBx6zwthaShUbSvfNbW7SQ4K4x3
vW1OdoGm7hRC4x+UqSL421uLeKvs0q3Brb5qTFcVQnLJtijsW7lmdWzV5DbElhw2
6T1Ta3S4UfJTqTf2nxYVvEfJMcp9xfJ32IzFDFSafFAn3jTiu9OWq+M3g7BfAyBk
rEkU163Tm31F79JGVm/Asa7Dmdl94Pq4vqT9wX+nbFsy5AFMWaz7bQpyVdCuAx+J
UQIDAQAB
-----END PUBLIC KEY-----
```

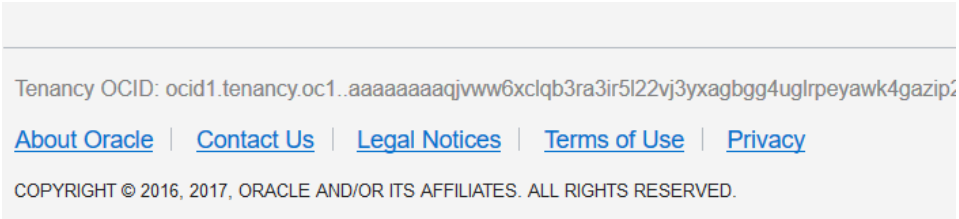
Navigate to user settings, add public key (upper left corner menu)



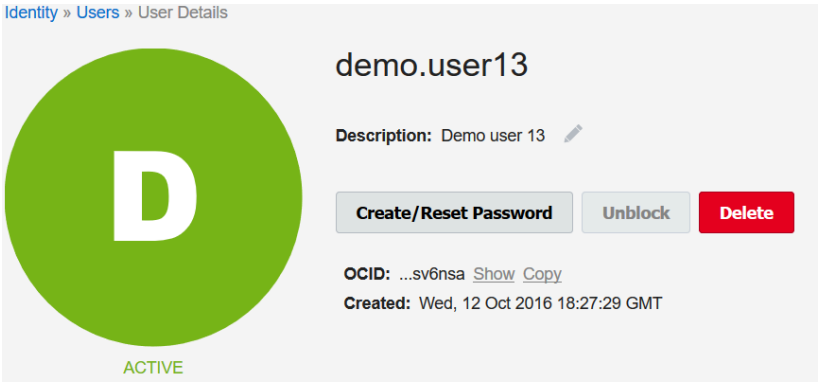
Create tf.env file, sets the environment variables used by terraform run.

Edit the values in tf.env with values from the cloud UI

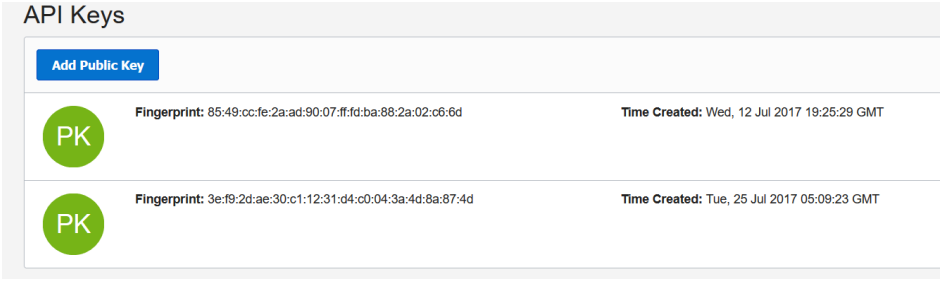
- **Tenancy OCID**: This is at the bottom of every page in the cloud UI (TF_VAR_tenancy_ocid)



- **User OCID**: This is on the user settings page (upper left corner menu) page, click copy to copy it straight from the webpage (TF_VAR_user_ocid), click on copy



- **Fingerprint**: Use the fingerprint from cloud UI (TF_VAR_fingerprint)



- **Compartment OCID**: Go to identity->compartments, then find your compartment. Click copy (TF_VAR_compartment_ocid)

- **Private Key Path:** Path to the previously generated private key (TF_VAR_private_key_path)
- **SSH Public Key:** openssh public key (TF_VAR_ssh_public_key, copy from file bmcs_api_key_pub.ssh)
- **PATH:** reflect binaries of Terraform

Typical tf.env file

```
cd ~/terraform workshop
[oracle@iostf-orakey workshop]$ cd ~/terraform workshop
[oracle@iostf-orakey workshop]$ cp ../terraform/tf.env .
[oracle@iostf-orakey workshop]$ cat tf.env
#!/bin/sh
echo $PATH | grep terraform >/dev/null
if [ $? -ne 0 ]
then
  export PATH=$PATH:$HOME/bin:$HOME/terraform
fi
export
TF VAR tenancy ocid=ocid1.tenancy.oc1..aaaaaaaadfcbr7fw2atbmpigwucbodxrnnshjy57jhvx45gvrqt7cz7mu2zq
export TF VAR user ocid=ocid1.user.oc1..aaaaaaaacfi6kx4zxwbfs3kobjfdmvq5aej222tup7v56yaaxdhtglahdhoq
export TF_VAR_fingerprint=e6:5b:8f:cf:c7:a5:dc:e0:19:5c:3a:c5:b3:74:fa:56
export TF_VAR_private_key_path=/home/oracle/.oraclebmc/bmcs_api_key.pem
export
TF VAR compartment ocid=ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2h
quuq
export TF VAR ssh public key="ssh-rsa
AAAAB3NzaC1yc2EAAAABJQAAAQEAmur3d4HOqvjyHCBLRe9AooC3twpBTWaO0X4ejfh7sgZ2BD7NMAbqf3Rma+k5f1t3OnBPz5xJZ0g
/dZ81Xl/g2wp4yoE7Fvf+sv6sSzD3O7yVQI+CqS6ga5XmSXkYqEdriUbIaY9kJfxEh65wleNGeWAnbFJRrtakKM92wo7rkq8vhW5Or2
```

```
sAKB9TC0Gh9vN2kOW1UDFyB14nZ7GlJ/MND5WRAKqBpORlNMejsFI0txiFly9A9l2vcmysXtKllNuVBrUIvz+bDS1stph3GlvC9e2bI
+3ye2QZcMhj/BBlMn2hsYh/OxPhpUXdvjtmjuo+VS+vgdvCq9GRbS6+uUjglw== rsa-key-20161129"
```

Set the public part of your ssh key to the variable TF_VAR_ssh_public_key to enable passwordless login later on.

Before terraform can be used, the provider has to be initialized

Terraform runs in 2 steps:

- Plan builds the graph with the delta between the current state on target and desired state
- Apply executes the graph built in step one

Finally the environment is cleaned up with the destroy statement.

When the file is complete, source the environment and run the init command

```
[oracle@iostf-orakey workshop]$ . tf.env

[oracle@iostf-orakey workshop]$ terraform init

Initializing provider plugins...

Terraform has been successfully initialized!

You may now begin working with Terraform. Try running "terraform plan" to see
any changes that are required for your infrastructure. All Terraform commands
should now work.

If you ever set or change modules or backend configuration for Terraform,
rerun this command to reinitialize your working directory. If you forget, other
commands will detect it and remind you to do so if necessary.
```

Try to run the small testscript. You should first run terraform plan, to review what terraform will do. Then, terraform apply to create the infrastructure, and terraform destroy to clean up afterwards.

The test script creates a simple cloud network, vcn. The script is run twice, first to create the graph, then to execute it. The commands are (run from workshop directory):

```
terraform plan vcn

terraform apply vcn
```

The commands will ask for the region for the OCI infrastructure, in the example below, us-phoenix-1 is used. The plan command:

```
[oracle@iostf-orakey workshop]$ terraform plan vcn
provider.oci.region
  (Required) The region for API connections (e.g. us-ashburn-1).

  Enter a value: us-phoenix-1

Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan, but will not be
persisted to local or remote state storage.


------------------------------------------------------------------------

An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  + create
```

```
Terraform will perform the following actions:

  + oci core virtual network.a TF managed VCN
      id:                       <computed>
      cidr block:               "10.0.0.0/16"
      compartment id:
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
      default_dhcp_options_id:  <computed>
      default route table id:   <computed>
      default security list id: <computed>
      display name:             "a TF managed VCN"
      state:                    <computed>
      time_created:             <computed>
      vcn_domain_name:          <computed>


Plan: 1 to add, 0 to change, 0 to destroy.

------------------------------------------------------------------------

Note: You didn't specify an "-out" parameter to save this plan, so Terraform
can't guarantee that exactly these actions will be performed if
"terraform apply" is subsequently run.

[oracle@iostf-orakey workshop]$
```

Then build the actual vcn example with apply

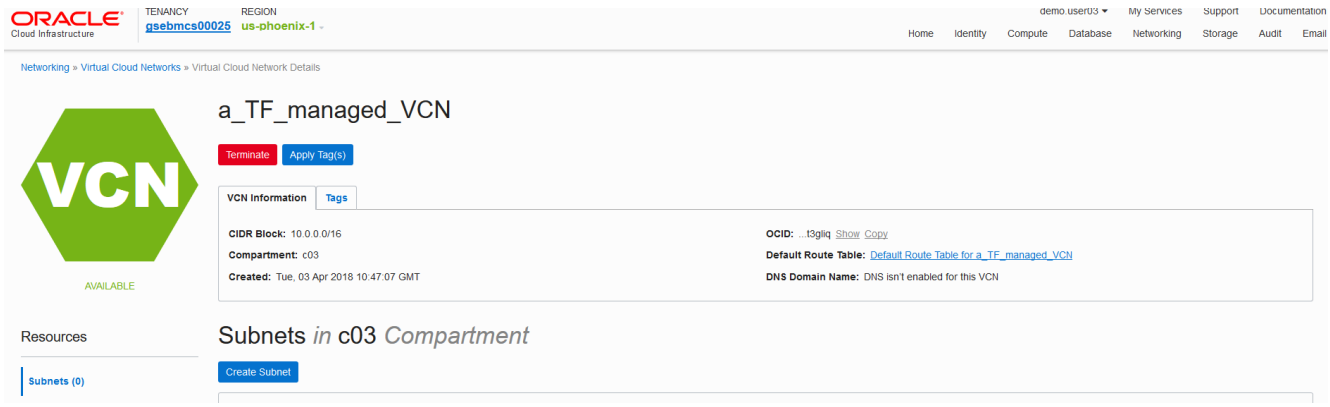
```
[oracle@iostf-orakey workshop]$ terraform apply vcn
provider.oci.region
  (Required) The region for API connections (e.g. us-ashburn-1).

  Enter a value: us-phoenix-1

oci_core_virtual_network.a_TF_managed_VCN: Creating...
  cidr block:               "" => "10.0.0.0/16"
  compartment id:           "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  default dhcp options id:  "" => "<computed>"
  default_route_table_id:   "" => "<computed>"
  default security list id: "" => "<computed>"
  display name:             "" => "a TF managed VCN"
  state:                    "" => "<computed>"
  time created:             "" => "<computed>"
  vcn domain name:          "" => "<computed>"
oci_core_virtual_network.a_TF_managed_VCN: Creation complete after 2s (ID:
ocid1.vcn.oc1.phx.aaaaaaaafd7c4hjp2jnjt6hvxidvuxlks5p74s6fvtm4enj62ao333t3gliq)

Apply complete! Resources: 1 added, 0 changed, 0 destroyed.
```

The following VCN is then created:



Finally cleanup with a destroy the infrastructure created

```
terraform destroy vcn
```

```
[oracle@iostf-orakey workshop]$ terraform destroy vcn
provider.oci.region
  (Required) The region for API connections (e.g. us-ashburn-1).

  Enter a value: us-phoenix-1

oci core virtual network.a TF managed VCN: Refreshing state... (ID:
ocid1.vcn.oc1.phx.aaaaaaaafd7c4hjp2jnjt6hvxidvuxlks5p74s6fvtm4enj62ao333t3gliq)

An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  - destroy

Terraform will perform the following actions:

  - oci core virtual network.a TF managed VCN


Plan: 0 to add, 0 to change, 1 to destroy.

Do you really want to destroy?
  Terraform will destroy all your managed infrastructure, as shown above.
  There is no undo. Only 'yes' will be accepted to confirm.

  Enter a value: yes

oci core virtual network.a TF managed VCN: Destroying... (ID:
ocid1.vcn.oc1.phx.aaaaaaaafd7c4hjp2jnjt6hvxidvuxlks5p74s6fvtm4enj62ao333t3gliq)
oci core virtual network.a TF managed VCN: Destruction complete after 4s

Destroy complete! Resources: 1 destroyed.
```

Now we will look at a more advanced example, in the infrastructure directory. Run the terraform plan infrastructure/, and then terraform apply infrastructure/

Terraform plan infrastructure

```
[oracle@iostf-orakey workshop]$ terraform plan infrastructure/
provider.oci.region
  (Required) The region for API connections (e.g. us-ashburn-1).

  Enter a value: us-phoenix-1
```

```
Refreshing Terraform state in-memory prior to plan...
The refreshed state will be used to calculate this plan, but will not be
persisted to local or remote state storage.

data.oci_identity_availability_domains.ADs: Refreshing state...

------------------------------------------------------------------------

An execution plan has been generated and is shown below.
Resource actions are indicated with the following symbols:
  + create
  ~ update in-place
 <= read (data resources)

Terraform will perform the following actions:

  ~ data.oci_core_vnic.dbserver_vnic
      id:                                   "" => <computed>
      availability_domain:                  "" => <computed>
      compartment_id:                       "" => <computed>
      display_name:                         "" => <computed>
      hostname_label:                       "" => <computed>
      is_primary:                           "" => <computed>
      mac_address:                          "" => <computed>
      private_ip_address:                   "" => <computed>
      public_ip_address:                    "" => <computed>
      skip_source_dest_check:               "" => <computed>
      state:                                "" => <computed>
      subnet_id:                            "" => <computed>
      time_created:                         "" => <computed>
      vnic_id:                              "" =>
"${lookup(data.oci_core_vnic_attachments.dbserver_vnics.vnic_attachments[0],\"vnic_id\")}"

  ~ data.oci_core_vnic.webserver_vnic
      id:                                   "" => <computed>
      availability_domain:                  "" => <computed>
      compartment_id:                       "" => <computed>
      display_name:                         "" => <computed>
      hostname_label:                       "" => <computed>
      is_primary:                           "" => <computed>
      mac_address:                          "" => <computed>
      private_ip_address:                   "" => <computed>
      public_ip_address:                    "" => <computed>
      skip_source_dest_check:               "" => <computed>
      state:                                "" => <computed>
      subnet_id:                            "" => <computed>
      time_created:                         "" => <computed>
      vnic_id:                              "" =>
"${lookup(data.oci_core_vnic_attachments.webserver_vnics.vnic_attachments[0],\"vnic_id\")}"

 <= data.oci_core_vnic_attachments.dbserver_vnics
      id:                                   <computed>
      availability_domain:                  "IScS:PHX-AD-3"
      compartment_id:
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
      instance_id:                          "${oci_core_instance.TF_dbserver.id}"
      vnic_attachments.#:                   <computed>

 <= data.oci_core_vnic_attachments.webserver_vnics
      id:                                   <computed>
      availability_domain:                  "IScS:PHX-AD-3"
      compartment_id:
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
      instance_id:                          "${oci_core_instance.TF_webserver.id}"
      vnic_attachments.#:                   <computed>
 baremetal_core_route_table.RouteForComplete_TF

……..


  + oci_core_virtual_network.CompleteVCN_TF
```

```
      id:                                       <computed>
      cidr_block:                               "172.16.0.0/16"
      compartment id:
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
      default dhcp options id:                  <computed>
      default route table id:                   <computed>
      default_security_list_id:                 <computed>
      display_name:                             "CompleteVCN_TF"
      state:                                    <computed>
      time created:                             <computed>
      vcn domain name:                          <computed>


Plan: 9 to add, 2 to change, 0 to destroy.

------------------------------------------------------------------------

Note: You didn't specify an "-out" parameter to save this plan, so Terraform
can't guarantee that exactly these actions will be performed if
"terraform apply" is subsequently run.
```

Terraform apply infrastructure

```
[oracle@iostf-orakey workshop]$ terraform apply infrastructure/
provider.oci.region
  (Required) The region for API connections (e.g. us-ashburn-1).

  Enter a value: us-phoenix-1

data.oci identity availability domains.ADs: Refreshing state...
oci_core_virtual_network.CompleteVCN_TF: Creating...
  cidr block:               "" => "172.16.0.0/16"
  compartment id:           "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  default dhcp options id:  "" => "<computed>"
  default route table id:   "" => "<computed>"
  default_security_list_id: "" => "<computed>"
  display name:             "" => "CompleteVCN TF"
  state:                    "" => "<computed>"
  time created:             "" => "<computed>"
  vcn domain name:          "" => "<computed>"
oci_core_virtual_network.CompleteVCN_TF: Creation complete after 0s (ID:
ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq)
oci core internet gateway.CompleteIG TF: Creating...
  compartment id: "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  display name:   "" => "CompleteIG TF"
  enabled:        "" => "true"
  state:          "" => "<computed>"
  time created:   "" => "<computed>"
  time modified:  "" => "<computed>"
  vcn id:         "" =>
"ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq"
oci_core_security_list.WebSubnet_TF: Creating...
  compartment id:                           "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  display name:                             "" => "Public"
  egress security rules.#:                  "" => "1"
  egress_security_rules.0.destination:      "" => "0.0.0.0/0"
  egress_security_rules.0.protocol:         "" => "6"
  egress security rules.0.stateless:        "" => "<computed>"
  ingress security rules.#:                 "" => "3"
  ingress_security_rules.0.protocol:        "" => "6"
```

```
  ingress_security_rules.0.source:            "" => "0.0.0.0/0"
  ingress_security_rules.0.stateless:         "" => "false"
  ingress security rules.0.tcp options.#:     "" => "1"
  ingress security rules.0.tcp options.0.max: "" => "80"
  ingress security rules.0.tcp options.0.min: "" => "80"
  ingress security rules.1.protocol:          "" => "6"
  ingress_security_rules.1.source:            "" => "172.16.0.0/16"
  ingress_security_rules.1.stateless:         "" => "false"
  ingress security rules.2.protocol:          "" => "6"
  ingress security rules.2.source:            "" => "0.0.0.0/0"
  ingress security rules.2.stateless:         "" => "false"
  ingress security rules.2.tcp options.#:     "" => "1"
  ingress_security_rules.2.tcp_options.0.max: "" => "22"
  ingress_security_rules.2.tcp_options.0.min: "" => "22"
  state:                                      "" => "<computed>"
  time created:                               "" => "<computed>"
  vcn id:                                     "" =>
"ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq"
oci_core_security_list.PrivateSubnet: Creating...
  compartment id:                        "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  display name:                          "" => "Private"
  egress_security_rules.#:               "" => "1"
  egress security rules.0.destination: "" => "172.16.0.0/16"
  egress security rules.0.protocol:    "" => "6"
  egress security rules.0.stateless:   "" => "<computed>"
  ingress security rules.#:            "" => "1"
  ingress security rules.0.protocol:   "" => "6"
  ingress_security_rules.0.source:     "" => "172.16.0.0/16"
  ingress security rules.0.stateless:  "" => "false"
  state:                               "" => "<computed>"
  time created:                        "" => "<computed>"
  vcn id:                              "" =>
"ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq"
oci_core_internet_gateway.CompleteIG_TF: Creation complete after 1s (ID:
ocid1.internetgateway.oc1.phx.aaaaaaaag...e4uom2456ocduziuxdn433r2elwt2w24kemaaq)
oci core route table.RouteForComplete TF: Creating...
  compartment id:                    "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  display_name:                      "" => "RouteTableForComplete"
  route_rules.#:                     "" => "1"
  route rules.0.cidr block:          "" => "0.0.0.0/0"
  route rules.0.network entity id: "" =>
"ocid1.internetgateway.oc1.phx.aaaaaaaagzhbrt2dvfjjcfe4uom2456ocduziuxdn433r2elwt2w24kemaaq"
  state:                             "" => "<computed>"
  time_created:                      "" => "<computed>"
  time modified:                     "" => "<computed>"
  vcn id:                            "" =>
"ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq"
oci core security list.WebSubnet TF: Creation complete after 0s (ID:
ocid1.securitylist.oc1.phx.aaaaaaaajo6z...nwsofa5udolchrt5wvl3mp7yg6pfd4ls26bz5a)
oci_core_route_table.RouteForComplete_TF: Creation complete after 0s (ID:
ocid1.routetable.oc1.phx.aaaaaaaa4ncf6v...nsuogaxrdvcnxdxorktwza5zabyyxkirjbbhiq)
oci core subnet.WebSubnet AD1 TF: Creating...
  availability domain:          "" => "IScS:PHX-AD-3"
  cidr block:                   "" => "172.16.1.0/24"
  compartment_id:               "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  dhcp options id:              "" => "<computed>"
  display name:                 "" => "WebSubnet AD1 TF"
  prohibit public ip on vnic:   "" => "<computed>"
  route_table_id:               "" =>
"ocid1.routetable.oc1.phx.aaaaaaaa4ncf6vrlbih5phnsuogaxrdvcnxdxorktwza5zabyyxkirjbbhiq"
  security_list_ids.#:          "" => "1"
  security list ids.3303963793: "" =>
"ocid1.securitylist.oc1.phx.aaaaaaaajo6z4sceu3x4s5nwsofa5udolchrt5wvl3mp7yg6pfd4ls26bz5a"
  state:                        "" => "<computed>"
  subnet_domain_name:           "" => "<computed>"
  time_created:                 "" => "<computed>"
  vcn id:                       "" =>
"ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq"
```

```
  virtual_router_ip:            "" => "<computed>"
  virtual_router_mac:           "" => "<computed>"
oci core security list.PrivateSubnet: Creation complete after 0s (ID:
ocid1.securitylist.oc1.phx.aaaaaaaaoa27...oxbkrq25r5gbaarrge7aemcyk6beco2obhw4lq)
oci core subnet.PrivateSubnetAD1 TF: Creating...
  availability domain:          "" => "IScS:PHX-AD-3"
  cidr_block:                   "" => "172.16.4.0/24"
  compartment_id:               "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  dhcp options id:              "" => "<computed>"
  display name:                 "" => "PrivateSubnetAD1 TF"
  prohibit public ip on vnic:   "" => "<computed>"
  route_table_id:               "" =>
"ocid1.routetable.oc1.phx.aaaaaaaa4ncf6vrlbih5phnsuogaxrdvcnxdxorktwza5zabyyxkirjbbhiq"
  security list ids.#:          "" => "1"
  security list ids.3320910217: "" =>
"ocid1.securitylist.oc1.phx.aaaaaaaaoa27oc54xlzr3hoxbkrq25r5gbaarrge7aemcyk6beco2obhw4lq"
  state:                        "" => "<computed>"
  subnet_domain_name:           "" => "<computed>"
  time created:                 "" => "<computed>"
  vcn id:                       "" =>
"ocid1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqffi3lmodiq"
  virtual_router_ip:            "" => "<computed>"
  virtual router mac:           "" => "<computed>"
oci core subnet.WebSubnet AD1 TF: Creation complete after 2s (ID:
ocid1.subnet.oc1.phx.aaaaaaaak32lq2gwb3...zly7wwcyexdrkkjxpvyetg7efreacalmhir3mq)
oci core instance.TF webserver: Creating...
  availability domain:          "" => "IScS:PHX-AD-3"
  compartment_id:               "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  create vnic details.#:        "" => "<computed>"
  display name:                 "" => "TF webserver"
  image:                        "" =>
"ocid1.image.oc1.phx.aaaaaaaaifdnkw5d7xvmwfsfw2rpjpxe56viepslmmisuyy64t3q4aiquema"
  ipxe_script:                  "" => "<computed>"
  metadata.%:                   "" => "1"
  metadata.ssh authorized keys: "" => "ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAABAQC7hwZI29PQzmDty0H6y7FRtzhEoZXfjuepj80abtQgzcZmgz9ucIUoxm85Zl4W22y3oJ0q9FK
p2NLqtKw8/C59g4dXyTLWMIdJjhAf/GJYP486bBspxsIalPK8bnUVcvQXZ2Cdrk0QTzmmWdrrAQ9ac/kW3g9t74E6J5pH+fFIaOF2rE
2zFbA9fRMZLlyKHOJm+iINL35RwLomHcrhtwVrToUa4SAx8kZvmcR2WBhMQuZvlVbtwUpuZl37g4srf8VEAKloGZId1T0L8V3Behbix
WMP3am/WX0LLiqp3vp4p88pWo3gIHO0n+z3+QyvgbatHTvNobrGp5BSmOoG8N/v"
  private ip:                   "" => "<computed>"
  public ip:                    "" => "<computed>"
  region:                       "" => "<computed>"
  shape:                        "" => "VM.Standard1.1"
  state:                        "" => "<computed>"
  subnet id:                    "" =>
"ocid1.subnet.oc1.phx.aaaaaaaak32lq2gwb3gctrzly7wwcyexdrkkjxpvyetg7efreacalmhir3mq"
  time created:                 "" => "<computed>"
oci core subnet.PrivateSubnetAD1 TF: Creation complete after 4s (ID:
ocid1.subnet.oc1.phx.aaaaaaaai6bspvfkrr...5jalzrdnhxy4ijgjcdl47upnhu427id3ws36uq)
oci_core_instance.TF_dbserver: Creating...
  availability domain:          "" => "IScS:PHX-AD-3"
  compartment id:               "" =>
"ocid1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhzdiulcuwrh3el4ow3od3x65jy2hquuq"
  create vnic details.#:        "" => "<computed>"
  display_name:                 "" => "a_TF_managed_dbserver"
  image:                        "" =>
"ocid1.image.oc1.phx.aaaaaaaaifdnkw5d7xvmwfsfw2rpjpxe56viepslmmisuyy64t3q4aiquema"
  ipxe script:                  "" => "<computed>"
  metadata.%:                   "" => "1"
  metadata.ssh_authorized_keys: "" => "ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAABAQC7hwZI29PQzmDty0H6y7FRtzhEoZXfjuepj80abtQgzcZmgz9ucIUoxm85Zl4W22y3oJ0q9FK
p2NLqtKw8/C59g4dXyTLWMIdJjhAf/GJYP486bBspxsIalPK8bnUVcvQXZ2Cdrk0QTzmmWdrrAQ9ac/kW3g9t74E6J5pH+fFIaOF2rE
2zFbA9fRMZLlyKHOJm+iINL35RwLomHcrhtwVrToUa4SAx8kZvmcR2WBhMQuZvlVbtwUpuZl37g4srf8VEAKloGZId1T0L8V3Behbix
WMP3am/WX0LLiqp3vp4p88pWo3gIHO0n+z3+QyvgbatHTvNobrGp5BSmOoG8N/v"
  private_ip:                   "" => "<computed>"
  public_ip:                    "" => "<computed>"
  region:                       "" => "<computed>"
  shape:                        "" => "VM.Standard1.1"
  state:                        "" => "<computed>"
```

```
  subnet_id:                    "" =>
"ocid1.subnet.oc1.phx.aaaaaaaai6bspvfkrraxcx5jalzrdnhxy4ijgjcdl47upnhu427id3ws36uq"
  time created:                 "" => "<computed>"
oci core instance.TF webserver: Still creating... (10s elapsed)
oci core instance.TF dbserver: Still creating... (10s elapsed)
oci core instance.TF webserver: Still creating... (20s elapsed)
oci_core_instance.TF_dbserver: Still creating... (20s elapsed)
oci_core_instance.TF_webserver: Still creating... (30s elapsed)
oci core instance.TF dbserver: Still creating... (30s elapsed)
oci core instance.TF webserver: Creation complete after 36s (ID:
ocid1.instance.oc1.phx.abyhqljsgnizrajd...a4zz2xyzfnazt5bbff5rvmmb5q4kwnrbq636ya)
data.oci core vnic attachments.webserver vnics: Refreshing state...
data.oci_core_vnic.webserver_vnic: Refreshing state...
oci_core_instance.TF_dbserver: Still creating... (40s elapsed)
oci core instance.TF dbserver: Creation complete after 47s (ID:
ocid1.instance.oc1.phx.abyhqljsnxw6zr7j...32rfxn6jhiy6kv7l5gumbaocu7atc63cbam6vq)
data.oci core vnic attachments.dbserver vnics: Refreshing state...
data.oci_core_vnic.dbserver_vnic: Refreshing state...

Apply complete! Resources: 9 added, 0 changed, 0 destroyed.

Outputs:

dbserver private ip = [
    172.16.4.2
]
dbserver public ip = [
    129.146.73.128
]
webserver private ip = [
    172.16.1.2
]
webserver public ip = [
    129.146.112.14
]
[oracle@iostf-orakey workshop]$
```

The IP addresses should be shown at the bottom of the script, try to ssh into the public address of both webserver and dbserver.

From the database server, run yum update, to update out of date packages.

Figure out why it fails, and how you can fix it.

Get the visual representation of the graph created by the plan command.

install graphviz as root

```
Install [root@iostf-orakey ~]# yum install graphviz
Loaded plugins: security, ulninfo
Setting up Install Process
Resolving Dependencies
```

Run terraform and pipe to the dot command

```
[oracle@iostf-orakey workshop]$ terraform graph infrastructure/ | dot -Tpng >../infra.png
```

Download and inspect the png file