
Oracle Cloud Infrastructure Labs

Oracle OCI, Terraform Provisioning

V2.0

ORACLE LAB BOOK | APRIL 2018

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The Oracle logo, consisting of the word "ORACLE" in white, uppercase, sans-serif font, set against a red rectangular background.



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 provided by the lecturer.

In the examples below, terraform is run from 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-orakey 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

Unzip 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:f2
```

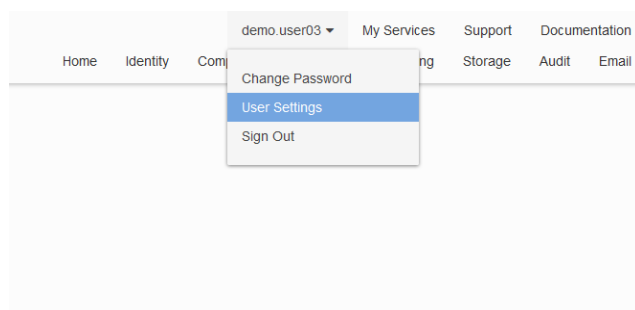
Generate the public key in OpenSSH RSA format:

```
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/zTQLif9MNMH1l83do2Uph+BYjBG95C57vzwtEqH0aCnO5s
cBh0EXJFvFPFem8tFI1e7lPtBUY1JbyUpfU2ivBx6zwthaShUbSvfNbW7SQ4K4x3
vW1OdoGm7hRC4x+UqSL42luLeKvs0q3Brb5qTFcVQnLJtjjsW7lmdWzV5DbElhw2
6T1Ta3S4UfJTqTf2nxYVvEfJMcp9xfJ32IzFDFsAfFAn3jTiu9OWq+M3g7BfAyBk
rEkU163Tm31F79JGVm/Asa7Dmdl94Pq4vqT9wX+nbFsy5AFMWaz7bQpyVdCuAx+J
UQIDAQAB
-----END PUBLIC KEY-----
```

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

Add Public Key
[help](#)
[cancel](#)

Note: Public Keys must be in the PEM format.

PUBLIC KEY

```
-----BEGIN PUBLIC KEY-----
MIIBIjANBgkqhkiG9w0BAQEFAAOCAQ8AMIIBCgKCAQEAsB56vBe9IZ3qYJwgKM7K
lGScSdnc8MRMGe5BP/zTQLif9MNMH1l83do2Uph+BYjBG95C57vzwtEqH0aCnO5s
cBh0EXJFvFPFem8tFI1e7lPtBUY1JbyUpfU2ivBx6zwthaShUbSvfNbW7SQ4K4x3
vW1OdoGm7hRC4x+UqSL42luLeKvs0q3Brb5qTFcVQnLJtjjsW7lmdWzV5DbElhw2
6T1Ta3S4UfJTqTf2nxYVvEfJMcp9xfJ32IzFDFsAfFAn3jTiu9OWq+M3g7BfAyBk
rEkU163Tm31F79JGVm/Asa7Dmdl94Pq4vqT9wX+nbFsy5AFMWaz7bQpyVdCuAx+J
UQIDAQAB
-----END PUBLIC KEY-----
```

Add

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)

```
Tenancy OCID: ocid1.tenancy.oc1..aaaaaaaqjvw6xclqb3ra3ir5i22vj3yxagbgga3ir5i22vj3yxagtzip;
```


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- **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



demo.user13

Description: Demo user 13 

[Create/Reset Password](#) [Unblock](#) [Delete](#)

OCID: ...sv6nsa [Show](#) [Copy](#)



Created: Wed, 12 Oct 2016 18:27:29 GMT

ACTIVE


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

API Keys

[Add Public Key](#)

	Fingerprint: 85:49:cc:fe:2a:ad:90:07:ff:fd:ba:88:2a:02:c6:6d	Time Created: Wed, 12 Jul 2017 19:25:29 GMT
	Fingerprint: 3e:f9:2d:ae:30:c1:12:31:d4:c0:04:3a:4d:8a:87:4d	Time Created: Tue, 25 Jul 2017 05:09:23 GMT

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



c13

OCID: ...j3etca [Show](#) [Copy](#)

Description: Compartment 13

- **Private Key Path:** Path to the previously generated private key (TF_VAR_private_key_path)
- **SSH Public Key:** openssl 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..aaaaaaaadfcbr7fw2atbmpqgwucbodxrnnshjy28jxhvq45gvrqt6cz5mu3zq
export TF_VAR user ocid=ocid1.user.oc1..aaaaaaaacfi5kx6zxwbfs2kobjfdmvq7ae888tup9v42yaaxdhtglahdhoq
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..aaaaaaaabozkb4ighhbkhonsalrhhdzdiulcuwrh4e13wo3od3x56jy2h
uqq
export TF_VAR ssh public key="ssh-rsa
AAAAB3NzaC1yc2EAAAABJQAAAQEAmur3d4HOqvjyHCBLRe9AocC3twpBTWa00X4ejfh7sgZ2BD7NMAbqf3Rma+k5f1t3OnBPz5xJZ0g
/dz81Xl/g2wp4yoE7Fvf+sv6sSzD3O7yVQI+CqS6ga5XmSxkYqEdriUbIaY9kJfxEh65wleNGeWAnbFJRrtakKM92ow7rkq8vhW5Or2
```

```
sAKB9TC0Gh9vN2kOW1UDFyB14nZ7GlJ/MND5WRAKqBpORlNMejsFI0txiFly9A9l2vcmysXtK1lNuVBrUIvz+bDS1stph3GlvC9e2bI+3ye2QZcMhj/BB1Mn2hsYh/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:
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhzdiulcuwrh3el4ow3od3x65jy2huqqu"
  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: "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhzdiulcuwrh3el4ow3od3x65jy2huqqu"
  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:
ocidl.vcn.oc1.phx.aaaaaaaafd7c4hjp2jnjt6hvxdvuxlks5p74s6fvtm4enj34ao666t3gliq)

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:
ocidl.vcn.oc1.phx.aaaaaaaafd7c4hjp2jnjt6hvxiadvxlks5p74s6fvmt4enj34a666t3gqliq)

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:
ocidl.vcn.oc1.phx.aaaaaaaafd7c4hjp2jnjt6hvxiadvxlks5p74s6fvmt4enj62ao333t3gqliq)
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:
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhdzdiulcuwrh3el4ow3od3x56jy2huqqu"
  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:
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhdzdiulcuwrh3el4ow3od3x56jy2huqqu"
  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:
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huququ"
    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: "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huququ"
  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:
ocidl.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq )
oci_core_internet_gateway.CompleteIG_TF: Creating...
  compartment id: "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huququ"
  display name: "" => "CompleteIG_TF"
  enabled: "" => "true"
  state: "" => "<computed>"
  time created: "" => "<computed>"
  time modified: "" => "<computed>"
  vcn id: "" => "ocidl.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq"
oci_core_security_list.WebSubnet_TF: Creating...
  compartment id: "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huququ"
  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:                              "" =>
"ocidl.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq "
oci_core_security_list.PrivateSubnet: Creating...
  compartment_id:      "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhdziulcuwrh3el4ow3od3x56jy2huqqu"
  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:               "" =>
"ocidl.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq "
oci_core_internet_gateway.CompleteIGTF: Creation complete after 1s (ID:
ocidl.internetgateway.oc1.phx.aaaaaaaag...e4uom2456ocduziuxdn433r2elwt2w24kemaag)
oci_core_route_table.RouteForCompleteTF: Creating...
  compartment_id:      "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhdziulcuwrh3el4ow3od3x56jy2huqqu"
  display_name:        "" => "RouteTableForComplete"
  route_rules.#:       "" => "1"
  route_rules.0.cidr_block: "" => "0.0.0.0/0"
  route_rules.0.network_entity_id: "" =>
"ocidl.internetgateway.oc1.phx.aaaaaaaagzhbrt2dvfjjcfe4uom2456ocduziuxdn433r2elwt2w24kemaag"
  state:                "" => "<computed>"
  time_created:         "" => "<computed>"
  time_modified:        "" => "<computed>"
  vcn_id:               "" =>
"ocidl.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq "
oci_core_security_list.WebSubnetTF: Creation complete after 0s (ID:
ocidl.securitylist.oc1.phx.aaaaaaaajo6z...nwsofa5udolchrt5wvl3mp7yg6pfd4ls26bz5a)
oci_core_route_table.RouteForCompleteTF: Creation complete after 0s (ID:
ocidl.routetable.oc1.phx.aaaaaaaan4ncf6v...nsuogaxrdvcnxdxorktwza5zabyyxkirjbbhiq)
oci_core_subnet.WebSubnetAD1TF: Creating...
  availability_domain: "" => "ISCS:PHX-AD-3"
  cidr_block:         "" => "172.16.1.0/24"
  compartment_id:     "" =>
"ocidl.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhhdziulcuwrh3el4ow3od3x56jy2huqqu"
  dhcp_options_id:    "" => "<computed>"
  display_name:       "" => "WebSubnet AD1 TF"
  prohibit_public_ip_on_vnic: "" => "<computed>"
  route_table_id:     "" =>
"ocidl.routetable.oc1.phx.aaaaaaaan4ncf6vrlbih5phnsuogaxrdvcnxdxorktwza5zabyyxkirjbbhiq"
  security_list_ids.#: "" => "1"
  security_list_ids.3303963793: "" =>
"ocidl.securitylist.oc1.phx.aaaaaaaajo6z4sceu3x4s5nwsofa5udolchrt5wvl3mp7yg6pfd4ls26bz5a"
  state:                "" => "<computed>"
  subnet_domain_name:   "" => "<computed>"
  time_created:         "" => "<computed>"
  vcn_id:               "" =>
"ocidl.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq "

```



```

virtual_router_ip:      "" => "<computed>"
virtual_router_mac:     "" => "<computed>"
oci core security list.PrivateSubnet: Creation complete after 0s (ID:
ocidl1.securitylist.oc1.phx.aaaaaaaaoa27...oxbkrq25r5gbaarrge7aemcyk6beco2obhw41q)
oci core subnet.PrivateSubnetAD1 TF: Creating...
  availability domain:   "" => "IScS:PHX-AD-3"
  cidr_block:           "" => "172.16.4.0/24"
  compartment_id:       "" =>
"ocidl1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huqu"
  dhcp options id:      "" => "<computed>"
  display name:         "" => "PrivateSubnetAD1 TF"
  prohibit public ip on vnic: "" => "<computed>"
  route_table_id:       "" =>
"ocidl1.routetable.oc1.phx.aaaaaaa4ncf6vrlbih5phnsuogaxrdvcnxdxorktwza5zabyyxkirjbbhiq"
  security list ids.#:  "" => "1"
  security list ids.3320910217: "" =>
"ocidl1.securitylist.oc1.phx.aaaaaaaaoa27oc54xlzr3hoxbkrq25r5gbaarrge7aemcyk6beco2obhw41q"
  state:                "" => "<computed>"
  subnet_domain_name:   "" => "<computed>"
  time created:         "" => "<computed>"
  vcn id:               "" =>
"ocidl1.vcn.oc1.phx.aaaaaaaav3d6y7t24rxkzqd2ocwfl66wsjvnfozujp7gaowenqidomlfiffq "
  virtual_router_ip:    "" => "<computed>"
  virtual_router_mac:   "" => "<computed>"
oci core subnet.WebSubnet AD1 TF: Creation complete after 2s (ID:
ocidl1.subnet.oc1.phx.aaaaaaaak32lq2gwb3...zly7wwcyexdrkkjxpvvetg7efreacalmhir3mq)
oci core instance.TF webserver: Creating...
  availability domain:   "" => "IScS:PHX-AD-3"
  compartment_id:       "" =>
"ocidl1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huqu"
  create vnic details.#: "" => "<computed>"
  display name:         "" => "TF webserver"
  image:                "" =>
"ocidl1.image.oc1.phx.aaaaaaaifdnkw5d7xvmwfsfw2rpjpxe56viepslmmisuyy64t3q4aiquema"
  ipxe_script:          "" => "<computed>"
  metadata.%:           "" => "1"
  metadata.ssh authorized keys: "" => "ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAQAC7hwZi29PQzmDty0H6y7FRtzhEoZXfjuepj80abtQgzcZmgz9ucIUoxm85Zl4W22y3oJ0q9FK
p2NLqtKw8/C59g4dXyTLWMIIdJjhAf/GJYP486bBspxsIalPK8bnUVcvQXZ2Cdrk0QTzmmWdrRAQ9ac/kW3g9t74E6J5pH+fFIaOF2rE
2zFbA9fRMZLlyKHOJm+iINL35RwLomHcrhtwVrToUa4SAx8kZcmvR2WBhMQuzv1VbtwUpuZl37g4srf8VEAKlogZId1T0L8V3Behbix
WMP3am/WX0LLiqp3vp4p88pWo3gIH00n+z3+QyvgbatHTvNobrgp5BSmOoG8N/v"
  private ip:           "" => "<computed>"
  public ip:            "" => "<computed>"
  region:               "" => "<computed>"
  shape:                "" => "VM.Standard1.1"
  state:                "" => "<computed>"
  subnet id:            "" =>
"ocidl1.subnet.oc1.phx.aaaaaaaak32lq2gwb3gctrzly7wwcyexdrkkjxpvvetg7efreacalmhir3mq"
  time created:         "" => "<computed>"
oci core subnet.PrivateSubnetAD1 TF: Creation complete after 4s (ID:
ocidl1.subnet.oc1.phx.aaaaaaaai6bspvfkrr...5jalzrdnhxy4ijgjcld147upnhu427id3ws36uq)
oci_core_instance.TF_dbserver: Creating...
  availability domain:   "" => "IScS:PHX-AD-3"
  compartment id:       "" =>
"ocidl1.compartment.oc1..aaaaaaaabozkb4ighhbkhonsalrhzhdiulcuwrh3el4ow3od3x56jy2huqu"
  create vnic details.#: "" => "<computed>"
  display_name:         "" => "a_TF_managed_dbserver"
  image:                "" =>
"ocidl1.image.oc1.phx.aaaaaaaifdnkw5d7xvmwfsfw2rpjpxe56viepslmmisuyy64t3q4aiquema"
  ipxe script:          "" => "<computed>"
  metadata.%:           "" => "1"
  metadata.ssh authorized keys: "" => "ssh-rsa
AAAAB3NzaC1yc2EAAAADAQABAAQAC7hwZi29PQzmDty0H6y7FRtzhEoZXfjuepj80abtQgzcZmgz9ucIUoxm85Zl4W22y3oJ0q9FK
p2NLqtKw8/C59g4dXyTLWMIIdJjhAf/GJYP486bBspxsIalPK8bnUVcvQXZ2Cdrk0QTzmmWdrRAQ9ac/kW3g9t74E6J5pH+fFIaOF2rE
2zFbA9fRMZLlyKHOJm+iINL35RwLomHcrhtwVrToUa4SAx8kZvmcR2WBhMQuzv1VbtwUpuZl37g4srf8VEAKlogZId1T0L8V3Behbix
WMP3am/WX0LLiqp3vp4p88pWo3gIH00n+z3+QyvgbatHTvNobrgp5BSmOoG8N/v"
  private ip:           "" => "<computed>"
  public ip:            "" => "<computed>"
  region:               "" => "<computed>"
  shape:                "" => "VM.Standard1.1"
  state:                "" => "<computed>"

```

```

subnet_id:                "" =>
"ocidl.subnet.oc1.phx.aaaaaaaai6bspvfkrraxcx5jalzrdnhxy4ijgjcld147upnhu427id3ws36uq"
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:
ocidl.instance.oc1.phx.abyhqljsgnizrajd...a4zz2xyzfnazt5bbff5rvmmmb5q4kwnrbq636ya)
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:
ocidl.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

