Terraform Tips and Tricks

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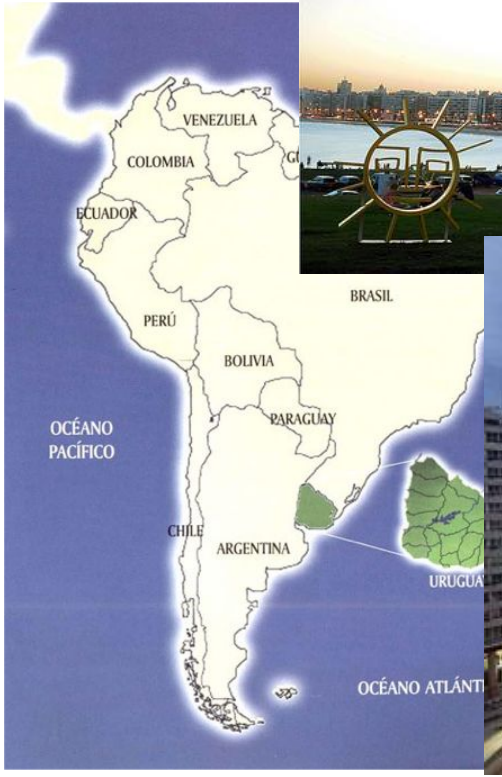
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Agenda

- ➔ Terraform basics (1 slide)
- ➔ Terraform Idiosyncrasy
- ➔ Cloud provider Idiosyncrasy

Terraform basics

- Infrastructure as Code, declarative config files (HCL)
- Simple install - standalone binary file
- Few operations - plan/apply/destroy
- Providers - implement how to deal with your resources. 1000+
- State file - mapping of existing resources to TF configuration
- Simple structure
  - Reads code from current directory
  - Split code in files for readability: main.tf, variables.tf, outputs.tf
- Advanced configurations - workspaces, modules, remote state files
- Changes in versions - Features, state file format

Terraform basics

- Infrastructure as Code, declarative config files (HCL)
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- Few operations - plan/apply/destroy
- Providers - implement how to deal with your resources. 1
- State file - mapping of existing resources to TF configura
- Simple structure
  - Reads code from current directory
  - Split code in files for readability: main.tf, variables.tf, output
- Advanced configurations - workspaces, modules, remote
- Changes in versions - Features, state file format
- https://www.terraform.io/
- Lucas' blog:

https://technology.amis.nl/continuous-delivery/provisioning/terraform/

```
terraform {
  required_providers {
    aws = {
      source  = "hashicorp/aws"
      version = "~> 3.27"
    }
  }
  required_version = ">= 0.14.9"
}

provider "aws" {
  profile = "default"
  region  = "us-west-1"
}

resource "aws_instance" "app_server" {
  ami           = "ami-830c94e3"
  instance_type = "t2.micro"

  tags = {
    Name = "AppServerInstance"
  }
}
```

Terraform idiosyncrasy

1) State file relevance
2) Concurrent work on same resources
3) Reducing scope of operations
4) Resource parameters validation
5) Re-using code
6) Available features = TF + provider

Terraform idiosyncrasy - 1) state file

Demo 1

Code taken from public Oracle repo (few changes for simplicity):
https://github.com/oracle/terraform-provider-oci/tree/master/examples/database/adb

Terraform idiosyncrasy - state file

```
$ terraform plan

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.aws_security_group.sgpr: Refreshing state...
------------------------------------------------------------------------

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:

  # aws_db_instance.master will be created
  + resource "aws_db_instance" "master" {
      + address                               = (known after apply)
      + allocated_storage                     = 500
      + apply_immediately                     = (known after apply)
...
      + identifier                            ="nelson-pg14"
...
Plan: 1 to add, 0 to change, 0 to destroy.
```

Terraform idiosyncrasy - state file

```
$ terraform plan

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.aws_security_group.sgpr: Refreshing state...
------------------------------------------------------------------------

An execu
Resource
  + crea

Terrafor

  # aws_
  + reso
      +
      +
      +
...
      + identifier                  ="nelson-pg14"
...
Plan: 1 to add, 0 to change, 0 to destroy.
```

```
$ aws rds describe-db-instances --region=us-west-1 --db-instance-identifier nelson-pg14
--query
"*[].{DBClusterIdentifier:DBClusterIdentifier,DBInstanceIdentifier:DBInstanceIdentifier,Engin
eVersion:EngineVersion}" --output table

-------------------------------------------------------------------------------------
|                        DescribeDBInstances                                        |
+---------------------+-------------------------+-----------------------------------+
| DBClusterIdentifier | DBInstanceIdentifier    |  EngineVersion                    |
+---------------------+-------------------------+-----------------------------------+
|  None               |  nelson-ora19           |  19.0.0.0.ru-2021-07.rur-2021-07.r1 |
+---------------------+-------------------------+-----------------------------------+
```

Terraform idiosyncrasy - state file

```
$ terraform plan

Refreshing Ter
The refreshed
persisted to l

data.aws_secur
--------------

An execu
Resource
  + crea

Terrafor

  # aws_
  + reso
      +
      +
      +
...
      + identifier                              ="nelson-pg14"
...
Plan: 1 to add, 0 to change, 0 to destroy.
```

```
$ terraform import aws_db_instance.master nelson-pg14

aws_db_instance.master: Importing from ID "nelson-pg14"...
aws_db_instance.master: Import prepared!
  Prepared aws_db_instance for import
aws_db_instance.master: Refreshing state... [id=nelson-pg14]

Import successful!

The resources that were imported are shown above. These resources are now in
your Terraform state and will henceforth be managed by Terraform.
```

```
$ aws                                                                    g14
--que
"*[].                                                                    ier,Engin
eVers
-----                                                                    --
|                        DescribeDBInstances                           |
+----------------------+-------------------------+-------------------------------------+
| DBClusterIdentifier | DBInstanceIdentifier    |  EngineVersion                      |
+----------------------+-------------------------+-------------------------------------+
|  None                |  nelson-ora19           |  19.0.0.0.ru-2021-07.rur-2021-07.r1 |
+----------------------+-------------------------+-------------------------------------+
```

Terraform idiosyncrasy - state file

```
$ terraform plan

Refreshing Ter
The refreshed
persisted to l

data.aws_secur
--------------

An execu
Resource
  + crea

Terrafor

  # aws_
  + reso
      +
      +
      +
...
      + identifier
...
Plan: 1 to add, 0 to change, 0 to destroy.
```

```
$ terraform import a

aws_db_instance.mast
aws_db_instance.mast
  Prepared aws_db_ir
aws_db_instance.mast

Import successful!

The resources that w
your Terraform state
```

```
$ aws
--que
"*[].
eVers

-----
|                    De
+--------------------+---
| DBClusterIdentifier | DB
+--------------------+---
|  None              |  r
+--------------------+---
```

```
$ terraform plan

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.aws_security_group.sgpr: Refreshing state...
aws_db_instance.master: Refreshing state... [id=nelson-pg14]

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

Terraform will perform the following actions:

  # aws_db_instance.master will be updated in-place
  ~ resource "aws_db_instance" "master" {
...
      + password                            = (sensitive value)
...
Plan: 0 to add, 1 to change, 0 to destroy.
```

Terraform idiosyncrasy - state file

```
$ terraform plan

Refreshing Ter
The refreshed
persisted to l

data.aws_secur
--------------

An execu
Resource
  + crea

Terrafor

  # aws_
  + reso
      +
      +
      +
...
      + identifier
...
Plan: 1 to add, 0 to change, 0 to destroy.
```

```
$ terraform import a

aws_db_instance.mast
aws_db_instance.mast
  Prepared aws_db_ir
aws_db_instance.mast

Import successful!

The resources that w
your Terraform state
```

```
$ aws
--que
"*[].
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-----
|                    De
+--------------------+---
| DBClusterIdentifier | DB
+--------------------+---
|  None              |  r
+--------------------+---
```

```
$ terraform plan

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  ~

Ter

  #
  ~
...

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

```
$ terraform apply
…
$ terraform plan

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.aws_security_group.sgpr: Refreshing state...
aws_db_instance.master: Refreshing state... [id=nelson-ora19]

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

No changes. Infrastructure is up-to-date.

This means that Terraform did not detect any differences between your
configuration and real physical resources that exist. As a result, no
actions need to be performed.
```

Terraform idiosyncrasy - state file

- Default state file is *terraform.tfstate* in current directory
- Critical data, requires good backup policy
- *terraform import* is not always able to recreate all attributes (ex: passwords, MySQL grants)
- Two key complementary features:
    - remote state file
      https://www.terraform.io/language/state/remote
    - OCI discovery
      https://registry.terraform.io/providers/oracle/oci/latest/docs/guides/resource_discovery

Terraform idiosyncrasy - state file / remote

- Remote state file - https://www.terraform.io/language/state/remote

```
remote_state {
  backend "s3" {
    bucket   = "terraform-states"
    key      = "networking/terraform.tfstate"
    region   = "us-phoenix-1"
    endpoint = "https://acme.compat.objectstorage.us-phoenix-1.oraclecloud.com"
    shared_credentials_file     = "../terraform-states_bucket_credentials"
    skip_region_validation      = true
    skip_credentials_validation = true
    skip_metadata_api_check     = true
    force_path_style            = true
  }
}
```

Ref: https://docs.oracle.com/en-us/iaas/Content/API/SDKDocs/terraformUsingObjectStore.htm

Terraform idiosyncrasy - state file / OCI discovery

Demo 2

OCI discovery docs: https://registry.terraform.io/providers/oracle/oci/latest/docs/guides/resource_discovery

Terraform idiosyncrasy - state file / OCI discovery

- *terraform-provider-oci* gets installed by terraform:

```
$ ls -lrt .terraform/providers/registry.terraform.io/hashicorp/oci/4.77.0/linux_amd64/
total 129320
-rw-r--r-- 1 calero calero     96384 May 31 17:31 CHANGELOG.md
-rw-r--r-- 1 calero calero     16725 May 31 17:31 LICENSE.md
-rw-r--r-- 1 calero calero      3071 May 31 17:31 README.md
-rwxr-xr-x 1 calero calero 132177920 May 31 17:31 terraform-provider-oci_v4.77.0
```

- Discover databases and create the state file:

```
$ mkdir discover
$ .terraform/providers/registry.terraform.io/hashicorp/oci/4.77.0/linux_amd64/terraform-provider-oci_v4.77.0
-command=export -compartment_id=$COMPID -services database -generate_state -output_path=../discover/
...
$ ls -lrt ../discover
total 44
-rw-r--r-- 1 calero calero 10109 May 31 18:46 terraform.tfstate.tmp.backup
-rw-r--r-- 1 calero calero 22086 May 31 18:46 terraform.tfstate
-rw-r--r-- 1 calero calero  6085 May 31 18:46 database.tf
-rw-r--r-- 1 calero calero    38 May 31 18:46 provider.tf
-rw-r--r-- 1 calero calero   171 May 31 18:46 vars.tf
$
```

Terraform idiosyncrasy - state file / OCI discovery

- *terraform-provider-oci* gets installed by terraform:

```
$ ls -lrt .terraform/providers/registry.terraform.io/hashicorp/oci/4.77.0/linux_amd64/
total 129320
-rw-r--r-- 1 calero calero     96384 May 31 17:31 CHANGELOG.md
-rw-r--r-- 1 calero calero     16725 May 31 17:31 LICENSE.md
-rw-r--r-- 1 calero calero      3071 May 31 17:31 README.md
-rwxr-xr-x 1 calero calero 132177920 May 31 17:31 terraform-provider-oci_v4.77.0
```

- Discover databases and create the state file:

```
$ mkdir di
$ .terrafo
-command=e
...
$ ls -lrt
total 44
-rw-r--r--
-rw-r--r--
-rw-r--r--
-rw-r--r--
-rw-r--r--
$
```

```
$ cd discover
$ terraform plan
oci_database_autonomous_database.export_example_autonomous_data_warehouse: Refreshing state...
[id=ocid1.autonomousdatabase.oc1.iad.anuwcljst77gzoiaaewxote6h4i73oamzoloxdueabnpwprspzngjoce52xq]
oci_database_autonomous_database.export_example_autonomous_database: Refreshing state...
[id=ocid1.autonomousdatabase.oc1.iad.anuwcljtt77gzoiamz3gg5cfsbdqgcoj7lrobis75qp7lwubm7d77bpblqgq]

No changes. Your infrastructure matches the configuration.

Terraform has compared your real infrastructure against your configuration and found no differences,
so no changes are needed.
$
```

Terraform idiosyncrasy - 2) concurrent work

```
$ terraform plan

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.aws_security_group.sgpr: Refreshing state...
aws_rds_cluster.master: Refreshing state... [id=nelson-auroramysql56]
aws_rds_cluster_instance.cluster_instances[0]: Refreshing state... [id=nelson-auroramysql56-0]
aws_rds_cluster_instance.cluster_instances[1]: Refreshing state... [id=nelson-auroramysql56-1]
mysql_user.monitor: Refreshing state... [id=monitor@%]

Error: Could not connect to server: dial tcp 127.0.0.1:3306: connect: connection refused
```

Terraform idiosyncrasy - concurrent work

```
$ terraform plan

Ref
The
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```

```
$ terraform plan
...
Error locking state: Error acquiring the state lock: ConditionalCheckFailedException: The conditional
request failed
Lock Info:
  ID:        f6f04b96-de6d-754a-7bbe-8d0504f75e79
  Path:      my-tf-state-286052569778/test/us-west-1/services/my-db/aurora-mysql/terraform.tfstate
  Operation: OperationTypePlan
  Who:       ncalero@tst-rds01
  Version:   0.12.31
  Created:   2021-12-28 13:45:41.113713713 +0000 UTC
  Info:

$
```

Terraform idiosyncrasy - concurrent work

```
$ terraform plan

Ref
The
per

dat
aws
aws
aws
mys

Err
```

```
$ terraform plan
...
Error locking state: Error acquiring the state lock: ConditionalCheckFailedException: The conditional
request failed
Lock Info:
  ID:        f6f04b96-de6d-754a-7bbe-8d0504f75e79
  Path:
  Operati
  Who:
  Version
  Created
  Info:

$
```

```
$ terraform force-unlock f6f04b96-de6d-754a-7bbe-8d0504f75e79
Do you really want to force-unlock?
  Terraform will remove the lock on the remote state.
  This will allow local Terraform commands to modify this state, even though it
  may be still be in use. Only 'yes' will be accepted to confirm.

  Enter a value: yes

Terraform state has been successfully unlocked!

The state has been unlocked, and Terraform commands should now be able to
obtain a new lock on the remote state.

$
```

Terraform idiosyncrasy - 3) reduce scope

```
$ terraform plan

data.oci_database_autonomous_db_versionstest_adb_versions: Reading...
oci_database_autonomous_database.autonomous_data_warehouse: Refreshing state...
[id=ocid1.autonomousdatabase.oc1.iad.anuwcljst77gzoiaaewxote6h4i73oamzoloxdueabnpwprspzngjoce52xq]
oci_database_autonomous_database.autonomous_database: Refreshing state...
[id=ocid1.autonomousdatabase.oc1.iad.anuwcljtt77gzoiamz3gg5cfsbdqgcoj7lrobis75qp7lwubm7d77bpblqgq]
data.oci_database_autonomous_databases.autonomous_databases: Reading...

...

Plan: 0 to a
```

```
$ terraform state list
data.http.ip
data.oci_database_autonomous_db_versions.test_adb_versions
oci_database_autonomous_database.autonomous_data_warehouse
oci_database_autonomous_database.autonomous_database
random_string.adb_admin_password

$ terraform plan -target oci_database_autonomous_database.autonomous_database
data.oci_database_autonomous_db_versions.test_adb_versions: Reading...
oci_database_autonomous_database.autonomous_database: Refreshing state...
[id=ocid1.autonomousdatabase.oc1.iad.anuwcljtt77gzoiamz3gg5cfsbdqgcoj7lrobis75qp7lwubm7d77bpblqgq]

No changes. Your infrastructure matches the configuration.
```

Terraform idiosyncrasy - 4) parameter validations

```
$ terraform apply
…
aws_rds_cluster.master[0]: Creating...
aws_rds_cluster.master[0]: Still creating... [10s elapsed]
aws_rds_cluster.master[0]: Still creating... [20s elapsed]
aws_rds_cluster.master[0]: Still creating... [30s elapsed]
aws_rds_cluster.master[0]: Still creating... [40s elapsed]
aws_rds_cluster.master[0]: Creation complete after 42s [id=my-aurora]
aws_rds_cluster_instance.cluster_instances[1]: Creating...
aws_rds_cluster_instance.cluster_instances[0]: Creating...

Error: error creating RDS Cluster (my-aurora) Instance: InvalidParameterCombination: RDS does not support creating a DB instance with the
following combination: DBInstanceClass=db.t3.small, Engine=aurora-mysql, EngineVersion=5.7. For supported combinations of instance class
and database engine version, see the documentation.
        status code: 400, request id: 7c15bd63-b7cf-47a3-8a10-faee35c3e9c4

  on main.tf line 7, in resource "aws_rds_cluster_instance" "cluster_instances":
   7: resource "aws_rds_cluster_instance" "cluster_instances" {



Error: error creating RDS Cluster (my-aurora) Instance: InvalidParameterCombination: RDS does not support creating a DB instance with the
following combination: DBInstanceClass=db.t3.small, Engine=aurora-mysql, EngineVersion=5.7. For supported combinations of instance class
and database engine version, see the documentation.
        status code: 400, request id: a8cb9644-fbe2-40ee-929b-18094709cb33

  on main.tf line 7, in resource "aws_rds_cluster_instance" "cluster_instances":
   7: resource "aws_rds_cluster_instance" "cluster_instances" {
```

Terraform idiosyncrasy - 4) parameter validations

- Terraform pass parameters to the provider - it runs the operation on the cloud service and it fails
- Some providers include *data sources* with *attributes* having a list of valid values for that (only if we use those when manipulating the resource)
  - Example: OCI Autonomous database https://registry.terraform.io/providers/oracle/oci/latest/docs/data-sources/database_autonomous_db_versions
- Additionally, simple validations can be incorporated in the variable definition:

```
$ grep -A13 "autonomous_database_db_workload" variables.tf
variable "autonomous_database_db_workload" {
  default = "OLTP"
  validation {
    condition = anytrue([
      var.autonomous_database_db_workload == "OLTP",
      var.autonomous_database_db_workload == "DW",
      var.autonomous_database_db_workload == "APEX",
      var.autonomous_database_db_workload == "AJD"
    ])
    error_message = "Invalid autonomous_database_db_workload value - allowed OLTP, DW, APEX and AJD."
  }
}
```

Terraform idiosyncrasy - parameter validations

Demo 3

Terraform idiosyncrasy – 5) reusing code

- Terraform by default read the current directory only
- Can include other directories using the "*module*" directive: https://learn.hashicorp.com/collections/terraform/modules

```
module "ec2_instances" {
  source  = "terraform-aws-modules/ec2-instance/aws"
  version = "3.5.0"
...
```

- Third party tools to re-using code (among environments and/or deployments) - **terragrunt** example:
  - Standardize resource attributes (tags, HA, networking, security, parameters) between deployments - in same or different environments and regions
  - Support different database engines and versions
  - Validations (possible but limited to same attribute expression)
  - Modules, variables and environments - directory structure
  - Extra features: hooks, functions, etc. - check https://terragrunt.gruntwork.io/

Terraform idiosyncrasy - 6) “features”

- Terraform binary
  - Aurora MySQL upgrade didn’t work on TF versions lower than 0.12.31 (current version: 1.1.7)
- Terraform provider
  - MySQL upgrade didn’t work with AWS provider lower than 3.63.0 (several bugs)
  - Resource discovery implemented in OCI (not in AWS as of today)
- Cloud provider limits/restrictions
  - Resource attributes are not validated (service restrictions) - cause runtime errors
    - allowed instance type for a RDS version (both ways)
    - IOPS parameter when using gp2 storage
    - CLI commands to the rescue (to confirm allowed values)

Cloud provider idiosyncrasy

- You can get errors today that does not repeat tomorrow, as services improves
- Don’t assume all services work the same for similar operations - RTFM!
- Examples on AWS:
  - MySQL minor upgrade fails without any error - not reproducible days later when repeating the test
  - RDS “create Aurora replica” is not available in some versions after upgrades
  - Aurora space used should be checked using metrics
  - RDS parameters have **apply_mode** immediate or pending-reboot, but tricky to update running instances automatically (immediate mode)
  - Operations on RDS storage does not allow other operations until they finish - and those can take long
    - Automatic space increment - minutes
    - Change type between gp2 and IOPS - hours

Terraform - parameters cheat sheet

Format code in .tf files	terraform fmt
Validate configuration	terraform validate
List state file resources	terraform state list
Inspect current state file content	terraform show
Remove a resource from state file	terraform state rm <name_in_state>
Import resource into state file	terraform import <name_in_state> <name_aws>
Remove lock from state file	terraform force-unlock <lock_id>
Operate on a single resource	terraform <op> -target <name_in_state>
Console (to test formulas/expressions)	terraform console
Debug execution	TF_LOG="TRACE" TF_LOG_PATH=file.log ; terraform <op>

Terraform console

```
[c_ncalero@myhost ~]$ terraform console
> substr("19.2",0,2)
19

> split(".","19.2")
[
  "19",
  "2",
]

> split(".","19.2")[0]
19

> element(split(".","19.2"),0)
19

> join("",["oracle",substr("19.2",0,2), "small"])
oracle19small

> join("",["oracle",split(".","19.2")[0]])
oracle19

> exit
```

OCI CLI - useful validations

- Available database versions for DB Systems using shape VM.Standard1.1

```
$ export COMPID=$(oci iam compartment list --query "data [?name=='mycmp'].{id:id}" | jq -r '.[].id')
$ oci db version list -c $COMPID --db-system-shape "VM.Standard1.1" --output table
+-----------------------------+--------------+-----------------+
| is-latest-for-major-version | supports-pdb | version         |
+-----------------------------+--------------+-----------------+
| True                        | False        | 11.2.0.4        |
| False                       | False        | 11.2.0.4.210119 |
| False                       | False        | 11.2.0.4.210420 |
| True                        | True         | 12.1.0.2        |
| False                       | True         | 12.1.0.2.211019 |
| False                       | True         | 12.1.0.2.220118 |
| False                       | True         | 12.1.0.2.220419 |
| True                        | True         | 12.2.0.1        |
| False                       | True         | 12.2.0.1.211019 |
| False                       | True         | 12.2.0.1.220118 |
| False                       | True         | 12.2.0.1.220419 |
| True                        | True         | 18.0.0.0        |
| False                       | True         | 18.16.0.0       |
| True                        | True         | 19.0.0.0        |
| False                       | True         | 19.13.0.0       |
| False                       | True         | 19.14.0.0       |
| False                       | True         | 19.15.0.0       |
| True                        | True         | 21.0.0.0        |
| False                       | True         | 21.4.0.0        |
| False                       | True         | 21.5.0.0        |
| False                       | True         | 21.6.0.0        |
+-----------------------------+--------------+-----------------+
```

OCI CLI - useful validations

- ADBs created in compartment ’mycmp’

```
$ export COMPID=$(oci iam compartment list --query "data [?name=='mycmp'].{id:id}" | jq -r '.[].id' )

$ oci db autonomous-database list -c $COMPID --query 'data[].{db_name:"db-name", db_version:"db-version",
db_workload:"db-workload", display_name:"display-name", state:"lifecycle-state"}' --output table

+--------------------+------------+-------------+-----------------------------------+------------+
| db_name            | db_version | db_workload | display_name                      | state      |
+--------------------+------------+-------------+-----------------------------------+------------+
| adbdw              | 19c        | DW          | example_autonomous_data_warehouse | AVAILABLE |
| adboltp            | 19c        | OLTP        | example_autonomous_database       | AVAILABLE |
+--------------------+------------+-------------+-----------------------------------+------------+
```

AWS CLI - useful validations

- Available Oracle EE versions for shape db.t3.small

```
$ aws rds describe-orderable-db-instance-options --engine oracle-ee --db-instance-class db.t3.small --query
"OrderableDBInstanceOptions[].{EngineVersion:EngineVersion}" --output text --region eu-west-1

12.1.0.2.v1
12.1.0.2.v10
12.1.0.2.v11
12.1.0.2.v12
12.1.0.2.v13
12.1.0.2.v14
12.1.0.2.v15
12.1.0.2.v16
12.1.0.2.v17
12.1.0.2.v18
12.1.0.2.v19
12.1.0.2.v2
12.1.0.2.v20
12.1.0.2.v21
12.1.0.2.v22
12.1.0.2.v23
12.1.0.2.v24
12.1.0.2.v25
12.1.0.2.v26
12.1.0.2.v27
12.1.0.2.v3
12.1.0.2.v4
12.1.0.2.v5
12.1.0.2.v6
12.1.0.2.v7
12.1.0.2.v8
12.1.0.2.v9
19.0.0.0.ru-2019-07.rur-2019-07.r1
19.0.0.0.ru-2019-10.rur-2019-10.r1
19.0.0.0.ru-2020-01.rur-2020-01.r1
19.0.0.0.ru-2020-04.rur-2020-04.r1
19.0.0.0.ru-2020-07.rur-2020-07.r1
19.0.0.0.ru-2020-10.rur-2020-10.r1
19.0.0.0.ru-2021-01.rur-2021-01.r1
19.0.0.0.ru-2021-01.rur-2021-01.r2
19.0.0.0.ru-2021-04.rur-2021-04.r1
19.0.0.0.ru-2021-07.rur-2021-07.r1
19.0.0.0.ru-2021-10.rur-2021-10.r1
19.0.0.0.ru-2022-01.rur-2022-01.r1
```

AWS CLI - useful validations

- Supported upgrade paths for Oracle version 12.1.0.2

```
$ aws rds describe-db-engine-versions --engine oracle-ee --engine-version 12.1.0.2.v20 --query
"DBEngineVersions[*].ValidUpgradeTarget[*].{EngineVersion:EngineVersion}" --output text

12.1.0.2.v21
12.1.0.2.v22
12.1.0.2.v23
12.1.0.2.v24
12.1.0.2.v25
12.1.0.2.v26
12.1.0.2.v27
19.0.0.0.ru-2020-04.rur-2020-04.r1
19.0.0.0.ru-2020-07.rur-2020-07.r1
19.0.0.0.ru-2020-10.rur-2020-10.r1
19.0.0.0.ru-2021-01.rur-2021-01.r1
19.0.0.0.ru-2021-01.rur-2021-01.r2
19.0.0.0.ru-2021-04.rur-2021-04.r1
19.0.0.0.ru-2021-07.rur-2021-07.r1
19.0.0.0.ru-2021-10.rur-2021-10.r1
19.0.0.0.ru-2022-01.rur-2022-01.r1
```

AWS CLI - useful validations

- Space in use by aurora Mysql instances running in region us-west-1

```
$ REGION=us-west-1; for i in $(aws cloudwatch list-metrics --region=$REGION --namespace AWS/RDS --metric-name
VolumeBytesUsed --query "Metrics[].Dimensions[].{Name:Name, Value:Value}" --output table | grep
DBClusterIdentifier | cut -d"|" -f3) ; do echo -n $i " " ; aws cloudwatch get-metric-statistics --region
$REGION --namespace AWS/RDS --metric-name VolumeBytesUsed --dimensions Name=EngineName,Value=aurora-mysql
--dimensions Name=EngineName,Value=aurora Name=DbClusterIdentifier,Value=$i --start-time $(date -u -d "1 days
ago" '+%F') --end-time $(date -u '+%F') --statistics Maximum --period 3600 --query
"Datapoints[].{Timestamp:Timestamp, Maximum:Maximum, Unit:Unit}" | jq '.[] | .Maximum' | sort -u | tail -1 ;
done | sort

bookshop-db         7381361362844
sales-db             179468653458
track-db              20681679872
programs-db           35563371113
analytics-db           8650433415
master-db             17432850551
resourcing-db          6418328690
…
```

AWS CLI - useful validations

- Parameters set by user (we) in a RDS parameter group

```
$ aws rds describe-db-parameters --db-parameter-group-name mypg --region us-west-1 --query
"sort_by(Parameters,&ParameterName)[?Source=='user'].{ParameterName:ParameterName, ApplyMethod:ApplyMethod,
IsModifiable:IsModifiable, ParameterValue:ParameterValue}" --output table

+----------------+--------------+-----------------------------------+------------------+
|   ApplyMethod  | IsModifiable |           ParameterName           | ParameterValue   |
+----------------+--------------+-----------------------------------+------------------+
|  immediate     |  True        |  event_scheduler                  |  ON              |
|  immediate     |  True        |  group_concat_max_len             |  16384           |
|  pending-reboot|  True        |  innodb_sort_buffer_size          |  8388608         |
|  immediate     |  True        |  log_bin_trust_function_creators  |  1               |
|  immediate     |  True        |  long_query_time                  |  0.1             |
|  pending-reboot|  True        |  max_allowed_packet               |  1073741824      |
|  immediate     |  True        |  max_connections                  |  8000            |
|  immediate     |  True        |  slow_query_log                   |  1               |
+----------------+--------------+-----------------------------------+------------------+
```

Thank You / Questions?

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