

Deploying with Terraform

Software Architecture

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Teacher Version

1 Before Class

Ensure you have had practice using the AWS Academy Learner Lab. It is preferable if you already have [Terraform installed](https://learn.hashicorp.com/tutorials/terraform/install-cli)¹. Please also have one of IntelliJ IDEA, PyCharm, or VSCode with the Terraform plugin installed.

2 This Week

This week we are going to deploy TaskOverflow our Todo Application to AWS using a hosted database and a single server website.

Specifically, this week you need to:

- Authenticate Terraform to use the AWS Learner Lab.
- Configure an RDS database.

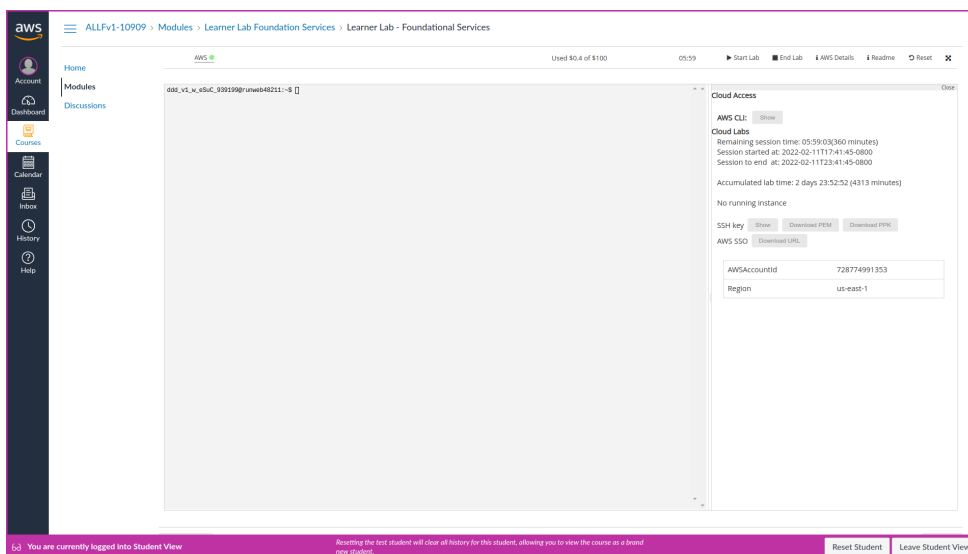
Path A Configure a single server and deploy the container.

Path B Configure an ECS cluster and deploy the container.

3 Using Terraform in AWS Learner Labs

Following the steps from the week four practical, start a Learner Lab in AWS Academy. For this practical, you do not need to create any resources in the AWS Console. The console can be used to verify that Terraform has correctly provisioned resources.

1. Once the Learner Lab has started, click on 'AWS Details' to display information about the lab.



¹<https://learn.hashicorp.com/tutorials/terraform/install-cli>

2. Click on the first 'Show' button next to 'AWS CLI' which will display a text block starting with [default].
3. Create a directory for this week's practical.
4. Within that directory create a `credentials` file and copy the contents of the text block into the file.
Do not share this file contents — do not commit it.
5. Create a `main.tf` file in the same directory with the following contents:

```
» cat main.tf

1 terraform {
2     required_providers {
3         aws = {
4             source = "hashicorp/aws"
5             version = "~> 4.0"
6         }
7     }
8 }

10 provider "aws" {
11     region = "us-east-1"
12     shared_credentials_files = [".credentials"]
13 }
```

The `terraform` block specifies the required external dependencies, here we need to use the AWS provider. The `provider` block configures the AWS provider, instructing it which region to use and how to authenticate (using the credentials file we created).

6. We need to initialise Terraform which will fetch the required dependencies. This is done with the `terraform init` command.

```
$ terraform init
```

This command will create a `.terraform` directory which stores providers and a provider lock file, `.terraform.lock.hcl`.

7. To verify that we have setup Terraform correctly, use `terraform plan`.

```
$ terraform plan
```

As we currently have no resources configured, it should find that no changes are required. Note that this does not ensure our credentials are correctly configured as Terraform has no reason to try authenticating yet.

4 Deploying a Database in AWS

Info

This section manually deploys a Postgresql RDS instance, which is not the course's end goal but is a good way to get started with AWS. Later in this practical we will use Terraform to create the database, so this section is optional and is better to be observed rather than actioned.

For the teacher

Instruct the class to observe you making the database and not to follow along.



Figure 1: Remote database deployment diagram

This is the last time we will heavily use the AWS user interface in the practicals. If you already feel confident in the AWS environment skip this section and move on to the next one.

For the teacher

Give students time to start the labs, could take up to 10 minutes.

To get started let us jump into the lab environment and have a look at AWS RDS which is an AWS managed database service. To get to the RDS service either search it or browse Services -> Database -> RDS as shown below.



Now we are in the management page for all our database instances, for today we just want to get a small instance running to explore the service. Head to “DB Instances (0/40)”.



This page should appear familiar as it is very similar to the AWS EC2 instance page. Let us create a new database by hitting the “Create Database” button.



Warning

In the next section we cannot use the Easy Create method as it tries to create a IAM account which is not allowed in the labs. Going forward we would typically do this using Terraform so we can easily avoid these restrictions.

For the teacher

Feel free to talk about the other offerings here, but make sure to flame Oracle and Microsoft SQL Server. A good thing to point out is the Amazon Aurora which is the serverless version of RDS.

We will be creating a standard database so select standard and Postgresql. We will use version 14, which is a fairly recent release.

Choose a database creation method [Info](#)

☒ Standard create

You set all of the configuration options, including ones for availability, security, backups, and maintenance.

☐ Easy create

Use recommended best-practice configurations. Some configuration options can be changed after the database is created.

Engine options

Engine type [Info](#)

☐ Amazon Aurora



☒ MySQL



☐ MariaDB



☐ PostgreSQL



☐ Oracle



☐ Microsoft SQL Server



Edition

☒ MySQL Community



Known issues/limitations

Review the [Known issues/limitations](#) [to learn about potential compatibility issues with specific database versions.](#)

Version

MySQL 8.0.27



For today we are going to use “Free Tier” but in the future, you may wish to explore the different deployment options. Please peruse the available different options.

For the teacher

Walk through what Multi-AZ means aka Multiple Availability Zones.

Templates

Choose a sample template to meet your use case.

☐ **Production**
Use defaults for high availability and fast, consistent performance.

☐ **Dev/Test**
This instance is intended for development use outside of a production environment.

☒ **Free tier**
Use RDS Free Tier to develop new applications, test existing applications, or gain hands-on experience with Amazon RDS.
[Info](#)

Availability and durability

Deployment options [Info](#)

The deployment options below are limited to those supported by the engine you selected above.

- ☐ **Single DB instance (not supported for Multi-AZ DB cluster snapshot)**
Creates a single DB instance with no standby DB instances.
- ☐ **Multi-AZ DB instance (not supported for Multi-AZ DB cluster snapshot)**
Creates a primary DB instance and a standby DB instance in a different AZ. Provides high availability and data redundancy, but the standby DB instance doesn't support connections for read workloads.
- ☐ **Multi-AZ DB Cluster - new**
Creates a DB cluster with a primary DB instance and two readable standby DB instances, with each DB instance in a different Availability Zone (AZ). Provides high availability, data redundancy and increases capacity to serve read workloads.

Now we need to name our database and create credentials to connect via. Here is where you can enter in credentials for the main account of the database.

Settings

DB instance identifier [Info](#)

Type a name for your DB instance. The name must be unique across all DB instances owned by your AWS account in the current AWS Region.

The DB instance identifier is case-insensitive, but is stored as all lowercase (as in "mydbinstance"). Constraints: 1 to 60 alphanumeric characters or hyphens. First character must be a letter. Can't contain two consecutive hyphens. Can't end with a hyphen.

▼ Credentials Settings

Master username [Info](#)

Type a login ID for the master user of your DB instance.

1 to 16 alphanumeric characters. First character must be a letter.

☐ Auto generate a password

Amazon RDS can generate a password for you, or you can specify your own password.

Master password [Info](#)

Constraints: At least 8 printable ASCII characters. Can't contain any of the following: / (slash), ' (single quote), " (double quote) and @ (at sign).

Confirm password [Info](#)

For exploring the process select t2.micro, which should be adequate for our needs.

For the teacher

May want to mention that burstable is not recommended for consistently used databases. Usually DBs are memory focused and thus the standard or memory optimised are used.

DB instance class

DB instance class [Info](#)

☐ Standard classes (includes m classes)

☐ Memory optimized classes (includes r and x classes)

☒ Burstable classes (includes t classes)

1 vCPUs 1 GiB RAM Not EBS Optimized



☐ Include previous generation classes

For storage we will leave all the default options.

Storage

Storage type [Info](#)

General Purpose SSD (gp2)
Baseline performance determined by volume size

Allocated storage

20

GiB

(Minimum: 20 GiB. Maximum: 16,384 GiB) Higher allocated storage **may improve** IOPS performance.

You might see better baseline performance with your selected volume size by specifying General Purpose SSD storage. [Learn more about using Provisioned IOPS storage for consistent performance.](#)

Storage autoscaling [Info](#)

Provides dynamic scaling support for your database's storage based on your application's needs.

☒

Enable storage autoscaling
Enabling this feature will allow the storage to increase once the specified threshold is exceeded.

Maximum storage threshold [Info](#)

Charges will apply when your database autoscales to the specified threshold

1000

GiB

Minimum: 21 GiB. Maximum: 16,384 GiB

In connectivity we need to make sure our instance is publicly available. Usually you do not want to expose your databases publicly and, would instead, have a web server sitting in-front. For our learning purposes though we are going to expose it directly just like we did with our EC2 instances early in the course.

When selecting public access as yes we have to create a new Security Group, give this Security Group a sensible name.

Connectivity



Virtual private cloud (VPC) [Info](#)

VPC that defines the virtual networking environment for this DB instance.

Default VPC (vpc-07f8e8ea0408a9db9) ▼

Only VPCs with a corresponding DB subnet group are listed.

After a database is created, you can't change its VPC.

Subnet group [Info](#)

DB subnet group that defines which subnets and IP ranges the DB instance can use in the VPC you selected.

default-vpc-07f8e8ea0408a9db9 ▼

Public access [Info](#)

☒ Yes

Amazon EC2 instances and devices outside the VPC can connect to your database. Choose one or more VPC security groups that specify which EC2 instances and devices inside the VPC can connect to the database.

☐ No

RDS will not assign a public IP address to the database. Only Amazon EC2 instances and devices inside the VPC can connect to your database.

VPC security group

Choose a VPC security group to allow access to your database. Ensure that the security group rules allow the appropriate incoming traffic.



Choose existing

Choose existing VPC security groups



Create new

Create new VPC security group

New VPC security group name

todoapp-manual

Availability Zone [Info](#)

No preference ▼

▼ Additional configuration

Database port [Info](#)

TCP/IP port that the database will use for application connections.

3306



We will leave the authentication as password based but we need to expand the “Additional configuration”. Fill in the “Initial Database Name” section to be “todo”, this is similar to what we had in the Docker Compose’s environment variable.

For the teacher

The other options here are to do with the parameters used to start the database, it is uncommon to have to change these but this is where any settings you would pass in via cli to the db would be set.

Database authentication

Database authentication options [Info](#)

- ☒ **Password authentication**
Authenticates using database passwords.
- ☐ **Password and IAM database authentication**
Authenticates using the database password and user credentials through AWS IAM users and roles.
- ☐ **Password and Kerberos authentication**
Choose a directory in which you want to allow authorized users to authenticate with this DB instance using Kerberos Authentication.

▼ Additional configuration

Database options, backup enabled, backtrack disabled, Enhanced Monitoring disabled, maintenance, CloudWatch Logs, delete protection disabled.

Database options

Initial database name [Info](#)

If you do not specify a database name, Amazon RDS does not create a database.

DB parameter group [Info](#)

Option group [Info](#)

Now we can click create which will take some time.

Estimated monthly costs

The Amazon RDS Free Tier is available to you for 12 months. Each calendar month, the free tier will allow you to use the Amazon RDS resources listed below for free:

- 750 hrs of Amazon RDS in a Single-AZ db.t2.micro Instance.
- 20 GB of General Purpose Storage (SSD).
- 20 GB for automated backup storage and any user-initiated DB Snapshots.

[Learn more about AWS Free Tier.](#)

When your free usage expires or if your application use exceeds the free usage tiers, you simply pay standard, pay-as-you-go service rates as described in the [Amazon RDS Pricing page.](#)

 You are responsible for ensuring that you have all of the necessary rights for any third-party products or services that you use with AWS services.

Cancel

Create database

Depending on your database it may take 10 to 30 minutes to create, the larger and more complicated the set-up, the longer it usually takes. The database will also do a initial backup when it is created.

RDS > Databases

Databases ☒ Group resources     

 DB identifier

Role

Engine

Region & AZ

Size

Status

CPU

| | | | | | | |
|--|----------|-----------------|------------|-------------|--|---------------------------------------|
|  todoapp-manual | Instance | MySQL Community | us-east-1f | db.t2.micro |  Backing-up | <div><div></div><div>100%</div></div> |
|--|----------|-----------------|------------|-------------|--|---------------------------------------|

When the database has finished being created you can select it to view the configuration and details. In this menu we also see the endpoint address which we will need to copy into our Docker Compose file.

Successfully created database [todoapp-manual](#)

View connection details

✕

[RDS](#) > [Databases](#) > [todoapp-manual](#)

todoapp-manual

Modify

Actions ▼

Summary

| | | | |
|---------------------------------|-----------------------------------|---------------------------|---------------------------|
| DB identifier todoapp-manual | CPU 10.83% | Status Available | Class db.t2.micro |
| Role Instance | Current activity 0 Connections | Engine MySQL Community | Region & AZ us-east-1f |

Connectivity & security

Monitoring

Logs & events

Configuration

Maintenance & backups

Tags

Connectivity & security

| | | |
|---|--|---|
| <div>Endpoint & port</div> <div>Endpoint</div> <div>todoapp-manual.cwvf1cdgoxaz.us-east-1.rds.amazonaws.com</div> <div>Port</div> <div>3306</div> | <div>Networking</div> <div>Availability Zone</div> <div>us-east-1f</div> <div>VPC</div> <div>vpc-07f8e8ea0408a9db9</div> <div>Subnet group</div> <div>default-vpc-07f8e8ea0408a9db9</div> <div>Subnets</div> <div> subnet-0556db549e22800f1 subnet-0da793726639bd6d8 subnet-091ee1d302ae831a9 subnet-0b932c4d6a4154b2a subnet-0416084227ea643b4 subnet-05d92ccc16a62294f </div> | <div>Security</div> <div>VPC security groups</div> <div> todoapp-manual2 (sg-0cc1a6ba52b85e23c) Active </div> <div>Publicly accessible</div> <div>Yes</div> <div>Certificate authority</div> <div>rds-ca-2019</div> <div>Certificate authority date</div> <div>August 23, 2024, 03:08 (UTC±3:08)</div> |
|---|--|---|

5 RDS Database with Terraform

Now would be a good time to browse the documentation for the RDS database in Terraform: https://registry.terraform.io/providers/hashicorp/aws/latest/docs/resources/db_instance. Using our manual configuration, we can come up with a resource with the appropriate parameters as below:

```
>> cat main.tf

locals {
  password = "foobarbaz" # this is bad
}

resource "aws_db_instance" "todoapp-database" {
  allocated_storage = 20
  max_allocated_storage = 1000
  engine = "postgres"
  engine_version = "14"
  instance_class = "db.t4g.micro"
  db_name = "todo"
  username = "todo"
```

```

password = local.password
parameter_group_name = "default.postgres14"
skip_final_snapshot = true
vpc_security_group_ids = [aws_security_group.todo-database.id]
publicly_accessible = true

tags = {
  Name = "todo-database"
}
}

```

Remember to create an appropriate security group as we did through the user interface.

```

» cat main.tf

resource "aws_security_group" "todo-database" {
  name = "database"
  description = "Allow inbound Postgresql traffic"

  ingress {
    from_port = 5432
    to_port = 5432
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }

  egress {
    from_port = 0
    to_port = 0
    protocol = "-1"
    cidr_blocks = ["0.0.0.0/0"]
    ipv6_cidr_blocks = [ ":::/0"]
  }

  tags = {
    Name = "todo-database"
  }
}

```

TODO: Connect to the database and explore around.

6 Container on AWS

As we mentioned in the Infrastructure as Code notes [1], in this course we will use Docker to configure machines and Terraform to configure infrastructure. AWS has the ability to deploy Docker containers using a service known as Elastic Container Service (ECS). We will cover ECS and deploying manually via EC2 so you can use the method you feel most comfortable with.

For this practical we have made available a Docker container running the todo application which you can use to deploy to AWS. This container is available on Github under the CSSE6400 organisation <https://ghcr.io/csse6400/taskoverflow:latest>. This container is very similar to what you have been building in the practicals but contains a simple UI and some extra features for the future practicals.

6.1 Setup

Of all the different ways that we can deploy our application we have already decided that we are going to offload the database to AWS. This means that we can move all the "state" of our application away from our containerised environment.

To start off we are going to use what we had above to create a database and the default Terraform. Edit your files so that they match what is provided below:

```
» cat main.tf

terraform {
  required_providers {
    aws = {
      source = "hashicorp/aws"
      version = "~> 4.0"
    }
  }
}

provider "aws" {
  region = "us-east-1"
  shared_credentials_files = ["/credentials"]
  default_tags {
    tags = {
      Course = "CSSE6400"
      Name = "TaskOverflow"
      Automation = "Terraform"
    }
  }
}

locals {
  image = "ghcr.io/csse6400/taskoverflow:latest"
  database_username = "administrator"
  database_password = "VerySecurePasswordByYourBoiEvan"
}

resource "aws_db_instance" "database" {
  allocated_storage = 20
  max_allocated_storage = 1000
  engine = "postgres"
  engine_version = "14"
  instance_class = "db.t4g.micro"
  db_name = "todo"
  username = local.database_username
}
```

```

password = local.database_password
parameter_group_name = "default.postgres14"
skip_final_snapshot = true
vpc_security_group_ids = [aws_security_group.database.id]
publicly_accessible = true
}

resource "aws_security_group" "database" {
  name = "todo-database"
  description = "Allow inbound Postgres traffic"

  ingress {
    from_port = 5432
    to_port = 5432
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }

  egress {
    from_port = 0
    to_port = 0
    protocol = "-1"
    cidr_blocks = ["0.0.0.0/0"]
    ipv6_cidr_blocks = [ "::/0" ]
  }
}

```

The above sets up a RDS instance of Postgres and a security group to allow access to it. We have also added a local variable to store the password for the database. Local variables in Terraform can come through two ways, they can be in a variables block which can be overridden or they can be in a locals block which can be used to store values that are used in multiple places.

Now we can run `terraform init` and `terraform apply` to create our database. Once this is done we can move on to the next step. For the next step you must choose a path to follow, either EC2 or ECS, only choose one path for the practical, if you have trouble with one path you can always switch to the other. When switching you should destroy the resources you have created so far before starting the new path.

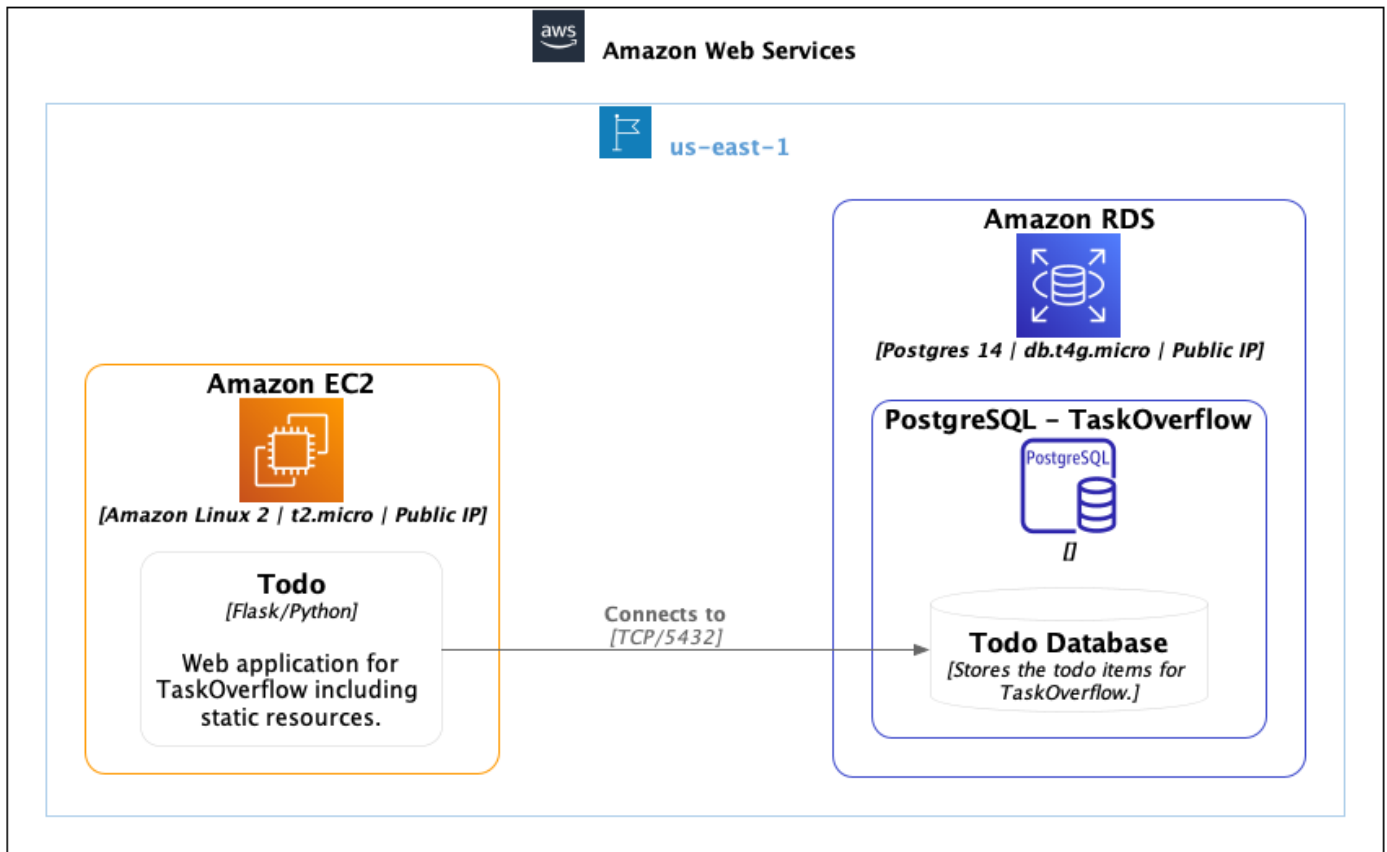
We recommend that you start with the ECS path as it is the more modern way of deploying containers and is the path that we will be suggesting for the future but all tasks are also doable using EC2.

6.2 [Path A] EC2

Aside

This is not the recommended path but is provided for those who would like to use EC2 instead of ECS. This is also the path that was used in the first run of the course (2022).

TaskOverflow on EC2 (Deployment Diagram)



Congrats you have chosen to go down the EC2 path which builds on what we experienced in the previous practicals. To deploy our application we first need to get the EC2 instance running and install Docker on the instance. We can do this by using the following Terraform code:

```
» cat main.tf

resource "aws_instance" "todo" {
  ami = "ami-005f9685cb30f234b" // Amazon Linux 2
  instance_type = "t2.micro"
  key_name = "vockey" // allows us to SSH into the instance using the preconfigured
    key

  user_data_replace_on_change = true // If we change user_data this will force the
    box to be recreated
  user_data = <<-EOT
#!/bin/bash
yum update -y
EOT

  security_groups = [aws_security_group.todo.name] // Firewall for the instance
}
```

Compared to the last time we used EC2 instances we have moved the `user_data` from a file to being defined in-line and we have made sure to provide the `key_name` in case we want to ssh into the deployed instance.

If we ran `terraform apply` now, our instance would not do anything interesting and we have not defined our security group yet. For the `user_data` we need to install Docker and run the container that we have already built. We can do this by changing our `user_data`:

```
» cat main.tf

user_data = <<-EOT
#!/bin/bash
yum update -y
yum install -y docker
service docker start
systemctl enable docker
usermod -a -G docker ec2-user
docker run --restart always -e SQLALCHEMY_DATABASE_URI=postgresql://${local.
    database_username}:${local.database_password}@${aws_db_instance.database.address
    }:${aws_db_instance.database.port}/${aws_db_instance.database.db_name} -p
    6400:6400 ${local.image}
EOT
```

The first lines install Docker and start the Docker service and allow the `ec2-user` to be able to run Docker commands. The last line is where the magic happens by running the container via the Docker cli. To get a refresher about the Docker cli please see the Containers lecture [2] and the [Docker documentation](#)².

Aside

The `-restart always` flag tells docker to restart the container if it crashes or is stopped. This is useful for our application as it may take a while for the database to be provisioned and we do not want to have to manually restart the container once the database is ready.

Now that our instance is ready to go we just need to make sure that it is accessible from the internet. We can do this by creating a security group that allows traffic on port 6400 and attaching it to our instance.

```
» cat main.tf

resource "aws_security_group" "todo" {
  name = "todo"
  description = "TaskOverflow Security Group"

  ingress {
    from_port = 6400
    to_port = 6400
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }
}
```

²<https://docs.docker.com/>

```

ingress {
  from_port = 22
  to_port   = 22
  protocol  = "tcp"
  cidr_blocks = ["0.0.0.0/0"]
}

egress {
  from_port = 0
  to_port   = 0
  protocol  = "-1"
  cidr_blocks = ["0.0.0.0/0"]
}
}

```

Now we can run `terraform init` and `terraform apply` to deploy our entire application. Once this is done we can visit the public IP of our instance on port 6400 to see our application running.

```

output "url" {
  value = "http://${aws_instance.todo.public_ip}:6400/"
}

```

You should be presented with a very lightweight todo application called TaskOverflow.

6.2.1 Finished Terraform

The below is the full terraform we built in this path.

```

» cat main.tf

terraform {
  required_providers {
    aws = {
      source = "hashicorp/aws"
      version = "~> 4.0"
    }
  }
}

provider "aws" {
  region = "us-east-1"
  shared_credentials_files = [".credentials"]
  default_tags {
    tags = {
      Course = "CSSE6400"
      Name = "TaskOverflow"
      Automation = "Terraform"
    }
  }
}

```

```

    }
}

locals {
    image = "ghcr.io/csse6400/taskoverflow:latest"
    database_username = "administrator"
    database_password = "VerySecurePasswordByYourBoiEvan"
}

resource "aws_db_instance" "database" {
    allocated_storage = 20
    max_allocated_storage = 1000
    engine = "postgres"
    engine_version = "14"
    instance_class = "db.t4g.micro"
    db_name = "todo"
    username = local.database_username
    password = local.database_password
    parameter_group_name = "default.postgres14"
    skip_final_snapshot = true
    vpc_security_group_ids = [aws_security_group.database.id]
    publicly_accessible = true
}

resource "aws_security_group" "database" {
    name = "todo-database"
    description = "Allow inbound Postgres traffic"

    ingress {
        from_port = 5432
        to_port = 5432
        protocol = "tcp"
        cidr_blocks = ["0.0.0.0/0"]
    }

    egress {
        from_port = 0
        to_port = 0
        protocol = "-1"
        cidr_blocks = ["0.0.0.0/0"]
        ipv6_cidr_blocks = [ "::/0" ]
    }
}

resource "aws_instance" "todo" {
    ami = "ami-005f9685cb30f234b"
    instance_type = "t2.micro"
    key_name = "vockey"

    user_data_replace_on_change = true
}

```

```

    user_data = <<-EOT
#!/bin/bash
yum update -y
yum install -y docker
service docker start
systemctl enable docker
usermod -a -G docker ec2-user
docker run --restart always -e SQLALCHEMY_DATABASE_URI=postgresql://${local.
    database_username}:${local.database_password}@${aws_db_instance.database.address
    }:${aws_db_instance.database.port}/${aws_db_instance.database.db_name} -p
    6400:6400 ${local.image}
EOT

    security_groups = [aws_security_group.todo.name]
}

resource "aws_security_group" "todo" {
    name = "todo"
    description = "TaskOverflow Security Group"

    ingress {
        from_port = 6400
        to_port = 6400
        protocol = "tcp"
        cidr_blocks = ["0.0.0.0/0"]
    }

    ingress {
        from_port = 22
        to_port = 22
        protocol = "tcp"
        cidr_blocks = ["0.0.0.0/0"]
    }

    egress {
        from_port = 0
        to_port = 0
        protocol = "-1"
        cidr_blocks = ["0.0.0.0/0"]
    }
}

output "url" {
    value = "http://${aws_instance.todo.public_ip}:6400/"
}

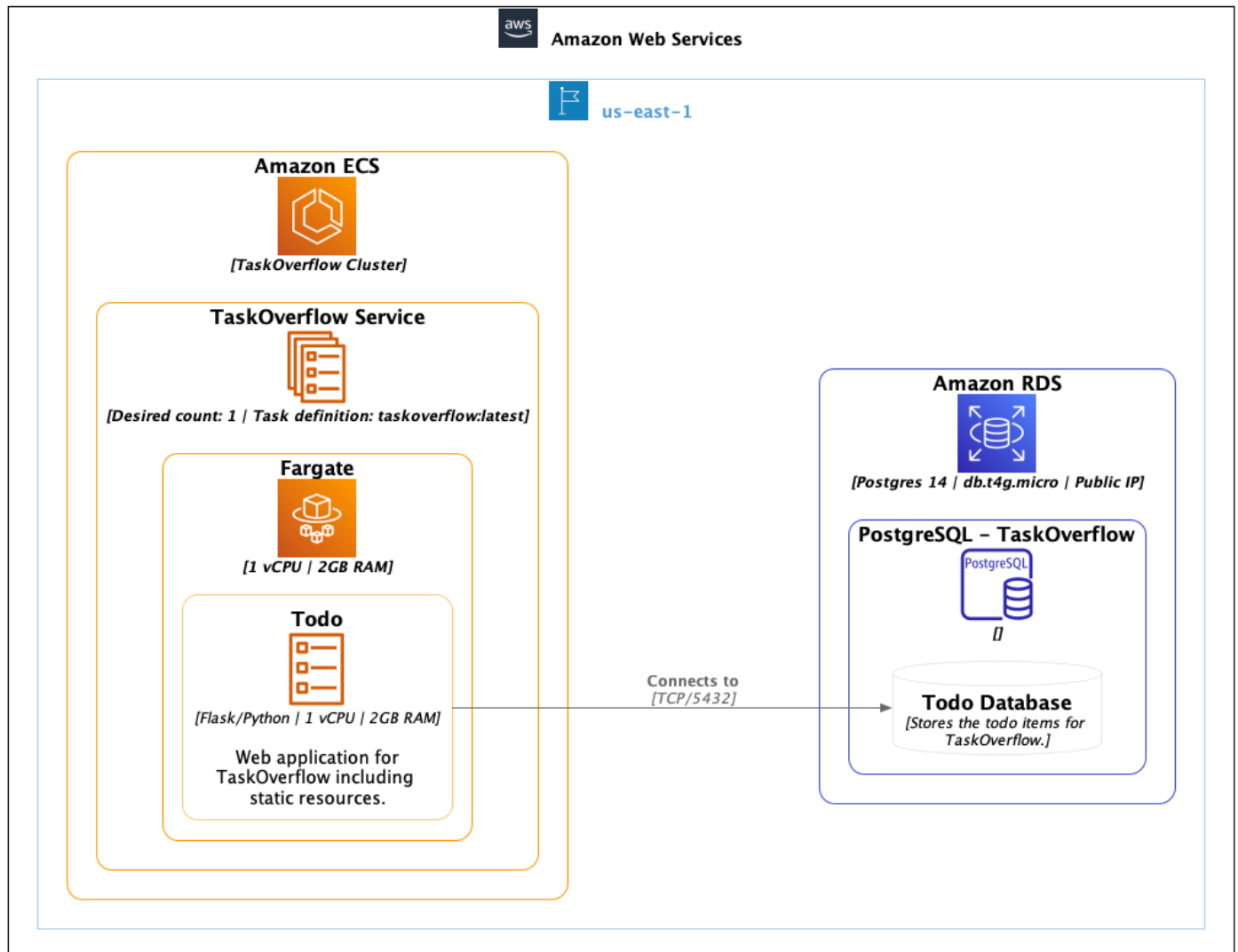
```

6.3 [Path B] ECS

Aside

This is the recommended path for the course and is the path that we will be suggesting for the future.

TaskOverflow on ECS (Deployment Diagram)



Legend
container

Congrats you have chosen to go down the ECS path which mimics the same environment that you have via Docker Compose but as a service on AWS. This path is new for the course this year so please let your tutors know of any issues you have.

To start off we need to get some information from our current AWS environment so that we can use it later. Add the below to fetch the IAM role known as LabRole which is a super user in the Lab environments which can do everything you can do through the UI. We will also be fetching the default VPC and the private subnets within that VPC because we need to set-up some networking for our ECS cluster.

```
data "aws_iam_role" "lab" {
  name = "LabRole"
```

```

}

data "aws_vpc" "default" {
  default = true
}

data "aws_subnets" "private" {
  filter {
    name = "vpc-id"
    values = [data.aws_vpc.default.id]
  }
}

```

The way in Terraform that we can get external information into the environment is by using data sources. These are just like resources but they are not created or destroyed see the below to see the syntactical differences.

```

data "aws_iam_role" "lab" {
  ...
}

resource "aws_db_instance" "database" {
  ...
}

```

```

» cat main.tf

resource "aws_ecs_task_definition" "todo" {
  family = "todo"
  network_mode = "awsvpc"
  requires_compatibilities = ["FARGATE"]
  cpu = 1024
  memory = 2048
  execution_role_arn = data.aws_iam_role.lab.arn

  container_definitions = <<DEFINITION
[
  {
    "image": "${local.image}",
    "cpu": 1024,
    "memory": 2048,
    "name": "todo",
    "networkMode": "awsvpc",
    "portMappings": [
      {
        "containerPort": 6400,
        "hostPort": 6400

```

```

    }
  ],
  "environment": [
    {
      "name": "SQLALCHEMY_DATABASE_URI",
      "value": "postgresql://${local.database_username}:${local.database_password}
        @${aws_db_instance.database.address}:${aws_db_instance.database.port}/${
        aws_db_instance.database.db_name}"
    }
  ],
  "logConfiguration": {
    "logDriver": "awslogs",
    "options": {
      "awslogs-group": "/taskoverflow/todo",
      "awslogs-region": "us-east-1",
      "awslogs-stream-prefix": "ecs",
      "awslogs-create-group": "true"
    }
  }
}
]
DEFINITION
}

```

```
» cat main.tf
```

```

resource "aws_ecs_cluster" "taskoverflow" {
  name = "taskoverflow"
}

```

```
» cat main.tf
```

```

resource "aws_ecs_service" "taskoverflow" {
  name = "taskoverflow"
  cluster = aws_ecs_cluster.taskoverflow.id
  task_definition = aws_ecs_task_definition.todo.arn
  desired_count = 1
  launch_type = "FARGATE"

  network_configuration {
    subnets = data.aws_subnets.private.ids
    security_groups = [aws_security_group.todo.id]
    assign_public_ip = true
  }
}

```



```

» cat main.tf

resource "aws_security_group" "todo" {
  name = "todo"
  description = "Task0verflow Security Group"

  ingress {
    from_port = 6400
    to_port = 6400
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }

  ingress {
    from_port = 22
    to_port = 22
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }

  egress {
    from_port = 0
    to_port = 0
    protocol = "-1"
    cidr_blocks = ["0.0.0.0/0"]
  }
}

```

6.3.1 Finished Terraform

```

» cat main.tf

terraform {
  required_providers {
    aws = {
      source = "hashicorp/aws"
      version = "~> 4.0"
    }
  }
}

provider "aws" {
  region = "us-east-1"
  shared_credentials_files = ["/credentials"]
  default_tags {
    tags = {
      Course = "CSSE6400"
    }
  }
}

```

```

        Name = "TaskOverflow"
        Automation = "Terraform"
    }
}

locals {
    image = "ghcr.io/csse6400/taskoverflow:latest"
    database_username = "administrator"
    database_password = "VerySecurePasswordByYourBoiEvan"
}

resource "aws_db_instance" "database" {
    allocated_storage = 20
    max_allocated_storage = 1000
    engine = "postgres"
    engine_version = "14"
    instance_class = "db.t4g.micro"
    db_name = "todo"
    username = local.database_username
    password = local.database_password
    parameter_group_name = "default.postgres14"
    skip_final_snapshot = true
    vpc_security_group_ids = [aws_security_group.database.id]
    publicly_accessible = true
}

resource "aws_security_group" "database" {
    name = "todo-database"
    description = "Allow inbound Postgres traffic"

    ingress {
        from_port = 5432
        to_port = 5432
        protocol = "tcp"
        cidr_blocks = ["0.0.0.0/0"]
    }

    egress {
        from_port = 0
        to_port = 0
        protocol = "-1"
        cidr_blocks = ["0.0.0.0/0"]
        ipv6_cidr_blocks = [ "::/0" ]
    }
}

data "aws_iam_role" "lab" {
    name = "LabRole"
}

```

```

resource "aws_ecs_cluster" "taskoverflow" {
  name = "taskoverflow"
}

resource "aws_ecs_task_definition" "todo" {
  family = "todo"
  network_mode = "awsvpc"
  requires_compatibilities = ["FARGATE"]
  cpu = 1024
  memory = 2048
  execution_role_arn = data.aws_iam_role.lab.arn

  container_definitions = <<DEFINITION
[
  {
    "image": "${local.image}",
    "cpu": 1024,
    "memory": 2048,
    "name": "todo",
    "networkMode": "awsvpc",
    "portMappings": [
      {
        "containerPort": 6400,
        "hostPort": 6400
      }
    ],
    "environment": [
      {
        "name": "SQLALCHEMY_DATABASE_URI",
        "value": "postgresql://${local.database_username}:${local.database_password}
          @${aws_db_instance.database.address}:${aws_db_instance.database.port}/${
            aws_db_instance.database.db_name}"
      }
    ],
    "logConfiguration": {
      "logDriver": "awslogs",
      "options": {
        "awslogs-group": "/taskoverflow/todo",
        "awslogs-region": "us-east-1",
        "awslogs-stream-prefix": "ecs",
        "awslogs-create-group": "true"
      }
    }
  }
]
DEFINITION
}

data "aws_vpc" "default" {

```

```

    default = true
}

data "aws_subnets" "private" {
  filter {
    name = "vpc-id"
    values = [data.aws_vpc.default.id]
  }
}

resource "aws_ecs_service" "taskoverflow" {
  name = "taskoverflow"
  cluster = aws_ecs_cluster.taskoverflow.id
  task_definition = aws_ecs_task_definition.todo.arn
  desired_count = 1
  launch_type = "FARGATE"

  network_configuration {
    subnets = data.aws_subnets.private.ids
    security_groups = [aws_security_group.todo.id]
    assign_public_ip = true
  }
}

resource "aws_security_group" "todo" {
  name = "todo"
  description = "TaskOverflow Security Group"

  ingress {
    from_port = 6400
    to_port = 6400
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }

  ingress {
    from_port = 22
    to_port = 22
    protocol = "tcp"
    cidr_blocks = ["0.0.0.0/0"]
  }

  egress {
    from_port = 0
    to_port = 0
    protocol = "-1"
    cidr_blocks = ["0.0.0.0/0"]
  }
}

```

6.4 [Path C] EKS / K8S

This path is not described in the course yet, but we recommend that if you liked the course to have a look at [Kubernetes](https://kubernetes.io/)³ as it is widely used in industry.

References

- [1] B. Webb, "Infrastructure as code," March 2022. <https://csse6400.uqcloud.net/handouts/iac.pdf>.
- [2] B. Webb, "Containers," March 2023. <https://csse6400.uqcloud.net/slides/containers.pdf>.

³<https://kubernetes.io/>