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# AWS 07 - Introduction to Amazon Redshift

# AWS sessions list

- AWS 01 AWS + Cloud Intro ✅ *1.5hrs*
- AWS 02 AWS CLI Setup ✅ *1.5hrs*
- AWS 03 S3 Storage (Console) ✅ *1.5hrs*
- AWS 04 CloudFormation Intro + S3 Storage (IaC) ✅ *1.5hrs*
- AWS 05 Lambda Intro ✅ *1.5hrs*
- AWS 06 Lambda (IaC) ✅ *1.5hrs*
- AWS 07 Redshift (IaC) ⬅ *1.5hrs*
- AWS 08 EC2 (IaC) + Grafana setup *1.5hrs*

# Overview

- Before Data Warehouses
- What is a Data Warehouse?
- Why use a Data Warehouse?
- Redshift as a Data Warehouse
- Connecting from a lambda using Python

# Learning Objectives

- What Redshift is and can do for us
- How to connect to it using Python
- Using Parameter Store to get settings
- Never put sensitive info like passwords in code or environment variables!

# Amazon Redshift

# Before Redshift - Traditional Data Warehouses

- Time consuming to pull data from many sources using traditional architecture
- Costly - hardware, setup, electricity, security, estate
- Maintenance costs often outweighed the benefits (upgrading systems due to more data being added)
- Performance issues
- Auto-scaling is not an easy concept

# Discussion (5 mins)

What is a data warehouse?

Why would we use it?

# Data Warehousing

- It intends to be where you keep your best data - the source of truth for your business
- It has been cleaned and transformed in preparation for storage
- Highly structured data that is ready for analysis

# Redshift

- Massively **parallel**, **column-oriented** database
- Simple and cost-effective to analyse your data
- Manages, monitors and scales your system
- Up to 10x better performance than traditional
- Collection of compute resources which are called nodes
- These nodes, when organised into groups, become **clusters**
- Each cluster runs a Redshift engine which contains one or more DBs

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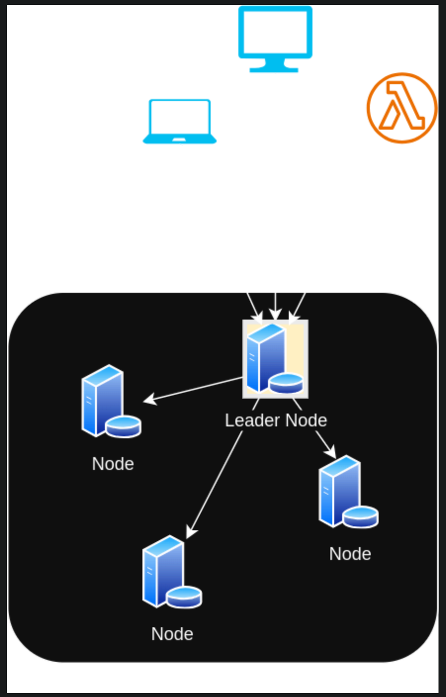
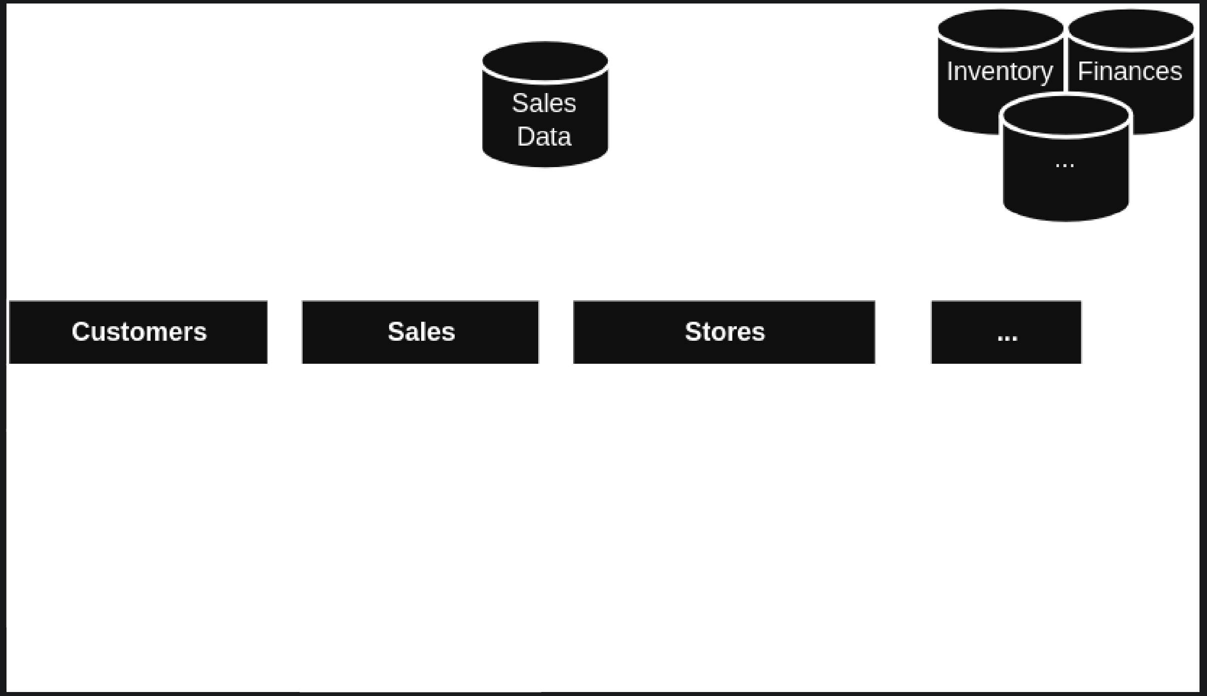
# Architecture

RedShift operates a complex model under the hood:



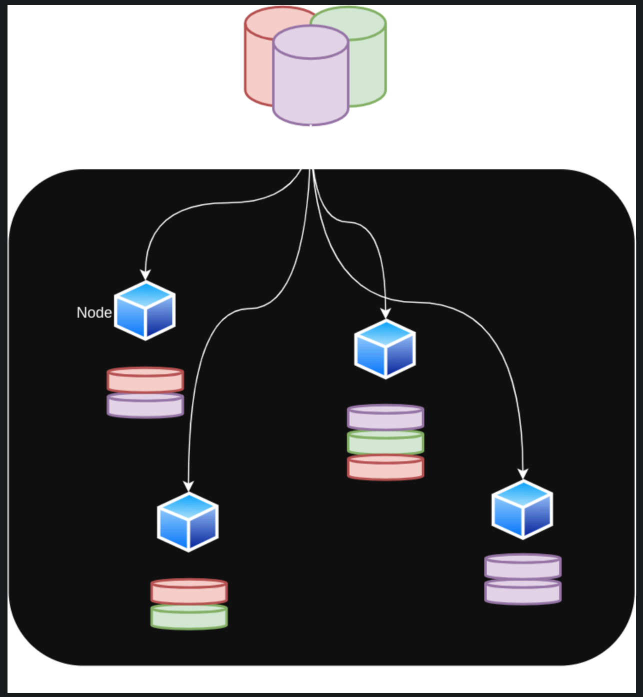
# Architecture

## Sample data



# Architecture

## Sharding



# Clusters

- A cluster has a leader node with one or more compute nodes
- The leader node receives queries from client applications (BI, analytical software etc.)

# Compute Nodes

- Compute resources which execute a query plan
- Transmits data among themselves to solve queries
- Nodes are further divided into (node) slices
- Each node slice receives an allocation of memory and performs operations in parallel

# Node types

- When you launch a (non-free tier) cluster, you need to specify the node types
- There are several types of node you can pick, including:
  - RA3
  - DC2 (Dense Compute)
  - DS2 (Dense Storage - *Legacy*)

# Choosing the right nodes:

- **Data Quantity:** Be aware of the amount of data you want to import into your Redshift cluster
- **Complexity of queries:** Different nodes support queries with differing levels of complexity
- **Downstream systems:** What uses the results of the queries? How important is query speed?

# Columnar Data Storage

- The data is still represented with rows and columns as normal
- However, the data is physically stored by column, instead of rows
- Because the data stored is the same type, you can achieve better data compression
- Number of I/O operations decreases
- Also means you can query/perform data analysis on similar types of data far quicker than row storage

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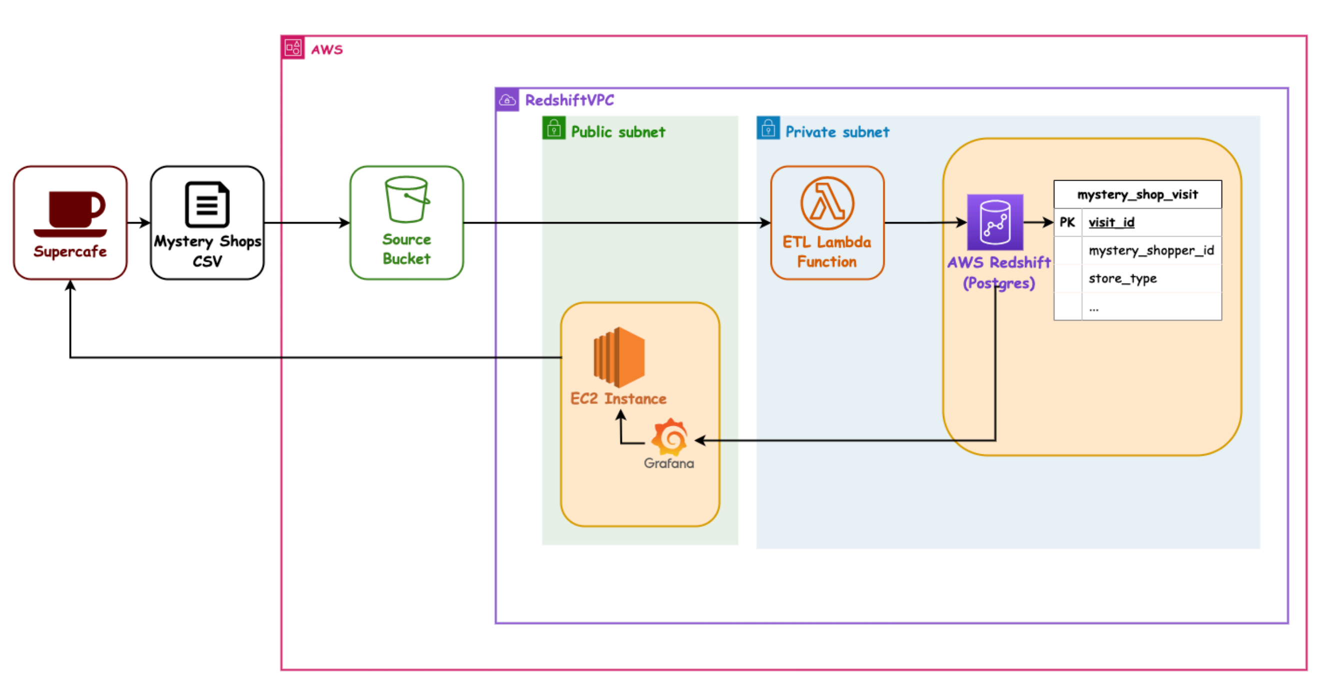
# Proposed Pipeline Architecture

Let's revisit our Mystery Shopper target setup:



# Our next user story

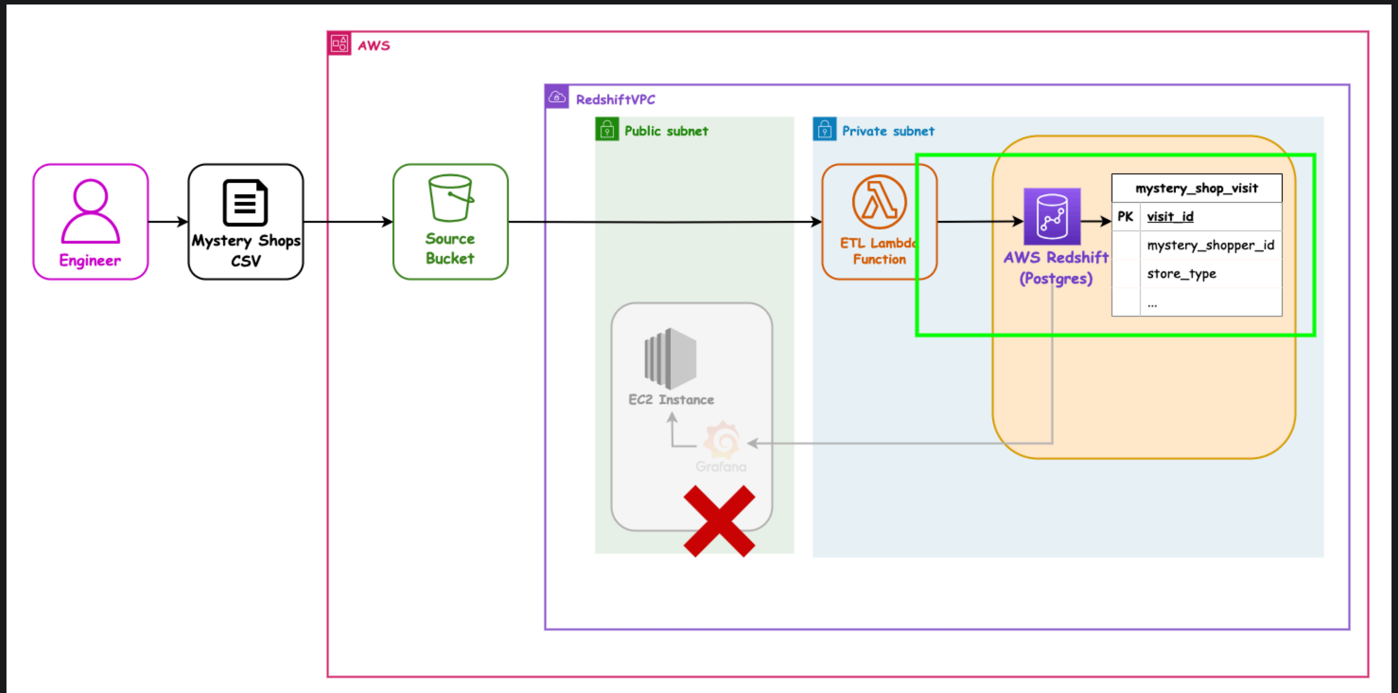
`As a` SuperCafe senior manager

`I want` the Mystery Shopper data to be analysed

`So that` we can award the friendliest most helpful store a prize each month

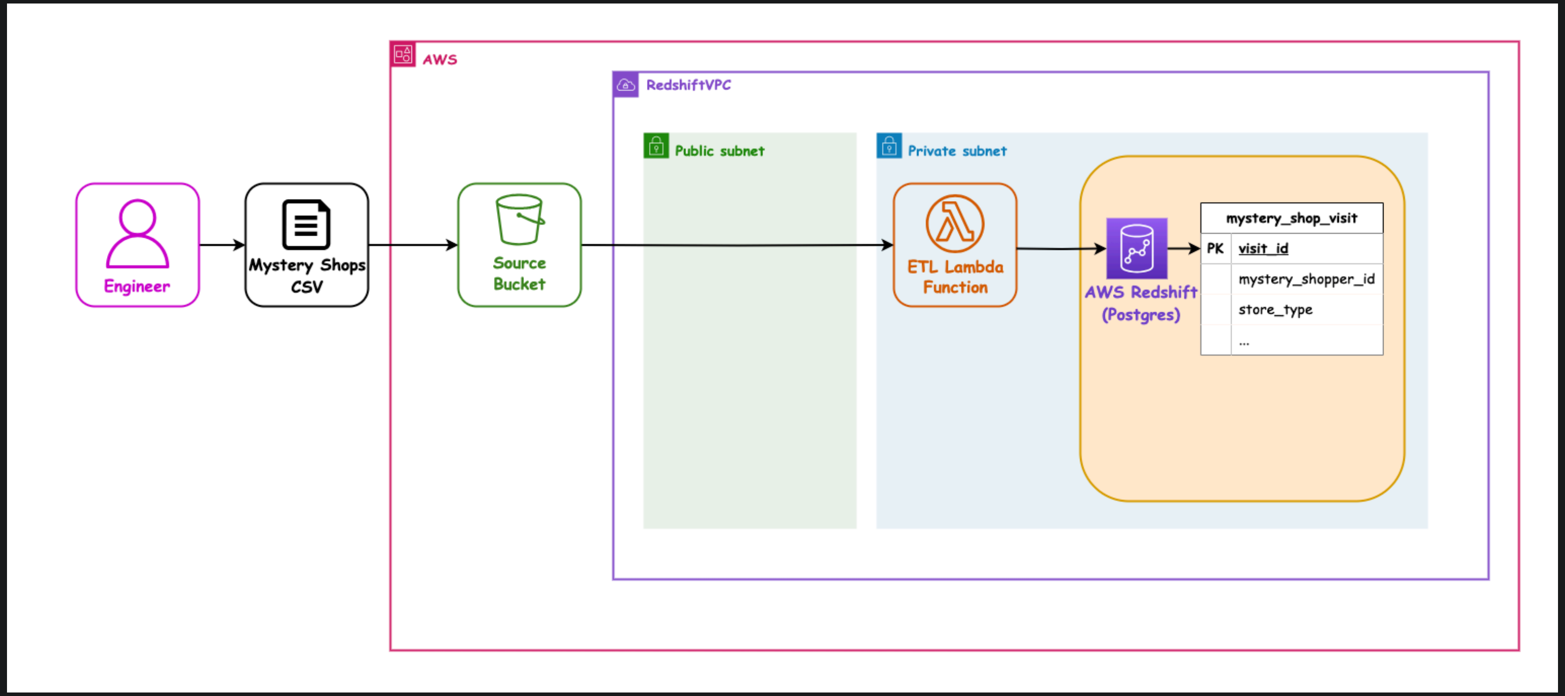
# Our next user story - Architecture

We want to check our data is going into the database, so that we can query it. We don't need the Grafana VM yet:



# Our next user story - Architecture

So for now we only need this chain of parts to be working:



| | mystery_shop_visit |
|---|---|
| PK | visit_id |
| | mystery_shopper_id |
| | store_type |
| | ... |

# Wait, no new CF templating?

> This session does not involve new CloudFormation *per-se* - rather, using tools already in our toolbox, we connect to RedShift, add data, and query it.
>
> The ETL Lambda python code provided in this session has been extended to talk to RedShift for us.

# Exercise time

Now we've learned a little bit about Amazon Redshift, let's implement loading some data from the Mystery Shopper pipeline into a database hosted on a Redshift cluster.

> Breakouts will be in each Project Team.

# Demo - new lambda code

We need to deploy the updated lambda code.

> Instructor to show the new lambda code.
>
> Especially important is the use of Parameter Store to get the connection details.

- See ./handouts/src/mystery_shop_etl_lambda.py
- And ./handouts/src/utils/db_utils.py
- And ./handouts/src/utils/sql_utils.py

# Exercise Prep: Your team name

Your team name will be provided by the instructors. It will have dashes in it (`-`) due to limitations in AWS (esp. Bucket names).

E.g if your team name is "La Vida Mocha", your logical team name will be `la-vida-mocha`.

You will need this!

> Note the dashes!

# Demo - Parameter Store settings

The RedShift connection details will be in a Parameter Store param called `<team_name>_redshift_settings`,
e.g.`la_vida_mocha_redshift_settings`, as Redshift likes underscores (`_`).

> Instructor to show each team their Parameter Store settings,
> e.g.`la_vida_mocha_redshift_settings`.

# Demo - the Deploy script - 5 mins

> The deploy script ./handouts/deploy.sh is done for you, so that it will reliably work.
>
> Instructor to show the file.

It does the following:

- Collect your `aws-profile` and `team-name` from the command line
- Deploy a stack called `team-name-shopper-deployment-bucket`
- Install the Lambda's dependencies in the `src` folder
- Package the `team-name-shopper-etl-pipeline` stack with Lambda Zip in S3
- Deploy a stack called `team-name-shopper-etl-pipeline`

# Exercise - Step 01 - Deploying

> 15 mins breakout
>
> Only ONE person should do this with the rest of the team watching... ...have a think about why!

- Follow Exercise Step 01 - Deploying
- Deploy the new lambda code using your team name e.g. `la-vida-mocha` (lower case with dashes)
- Run `./deploy.sh <profile-name> <team-name>` to update the ETL lambda function:
  - e.g. `./deploy.sh sot-academy la-vida-mocha`

# Discussion - Step 01 - Deploying

> How did the deployment go?
>
> Is everyone happy they understand it?

- Why could only **ONE** person from each Team do this?

# Exercise - Step 02 - Trigger lambda

> 5 mins breakout

- Follow Exercise Step 02 - Trigger lambda
- Use file ./handouts/data/mystery_shops_2024-03.csv
- You can upload the same file many times, or altered copies of it
- Multiple team members can do this concurrently
  - Why is that?

# Discussion - Step 02 - Trigger lambda

> How did the triggering go?
>
> Is everyone happy they understand it?

- Why could multiple people do this at the same time?

# Demo - Step 03 - RedShift Query Editor

> The Instructor will now demo how to connect to the RedShift query editor in the AWS Console, using the Parameter Store data, e.g. `la_vida_mocha_redshift_settings`.

# Exercise - Step 03 - Create SQL Queries

- 20 mins breakout

> Follow Exercise Step 03 - Create SQL Queries.
>
> Use the RedShift query editor in the AWS Console.

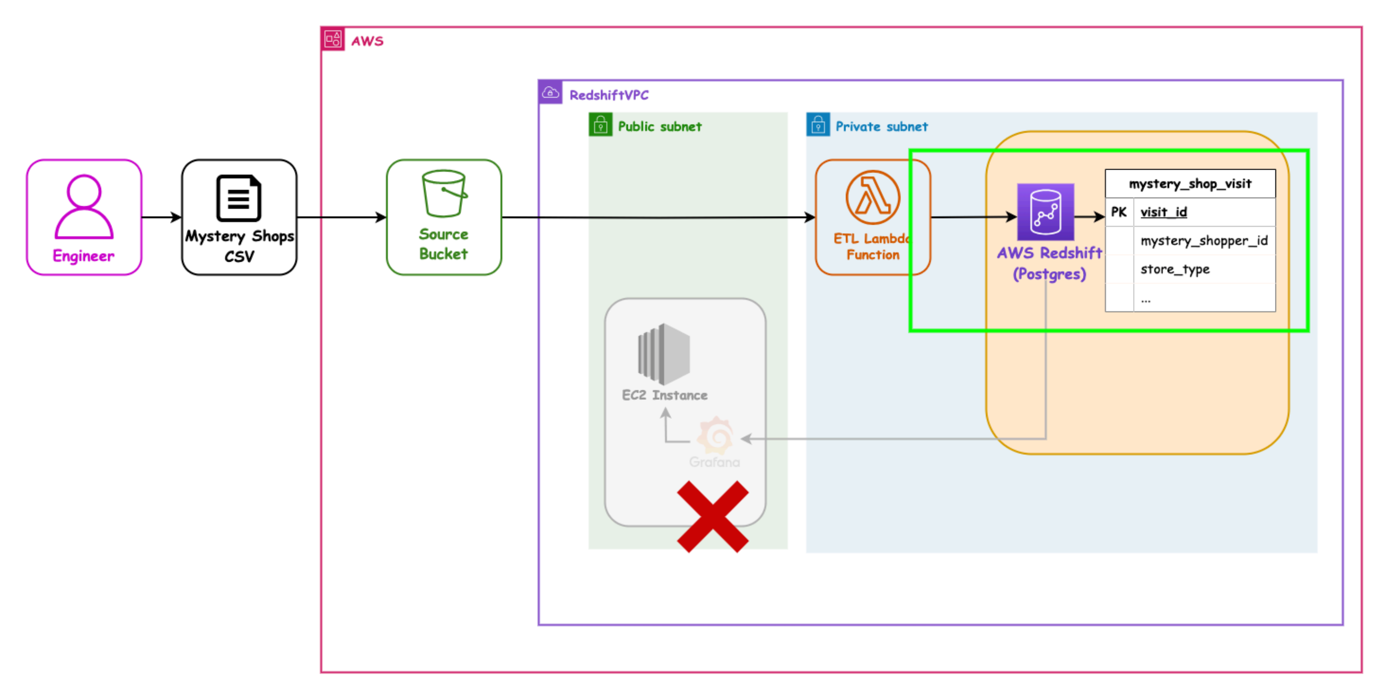
- You can all do this concurrently (not just one person per team)
- Start with `select * from mystery_shop_visit;` and then see if you can do something more sophisticated

# Discussion - Step 03 - Create SQL Queries

> How did the SQL-ing go?
>
> Is everyone happy they understand the queries?

# Our next user story - Architecture

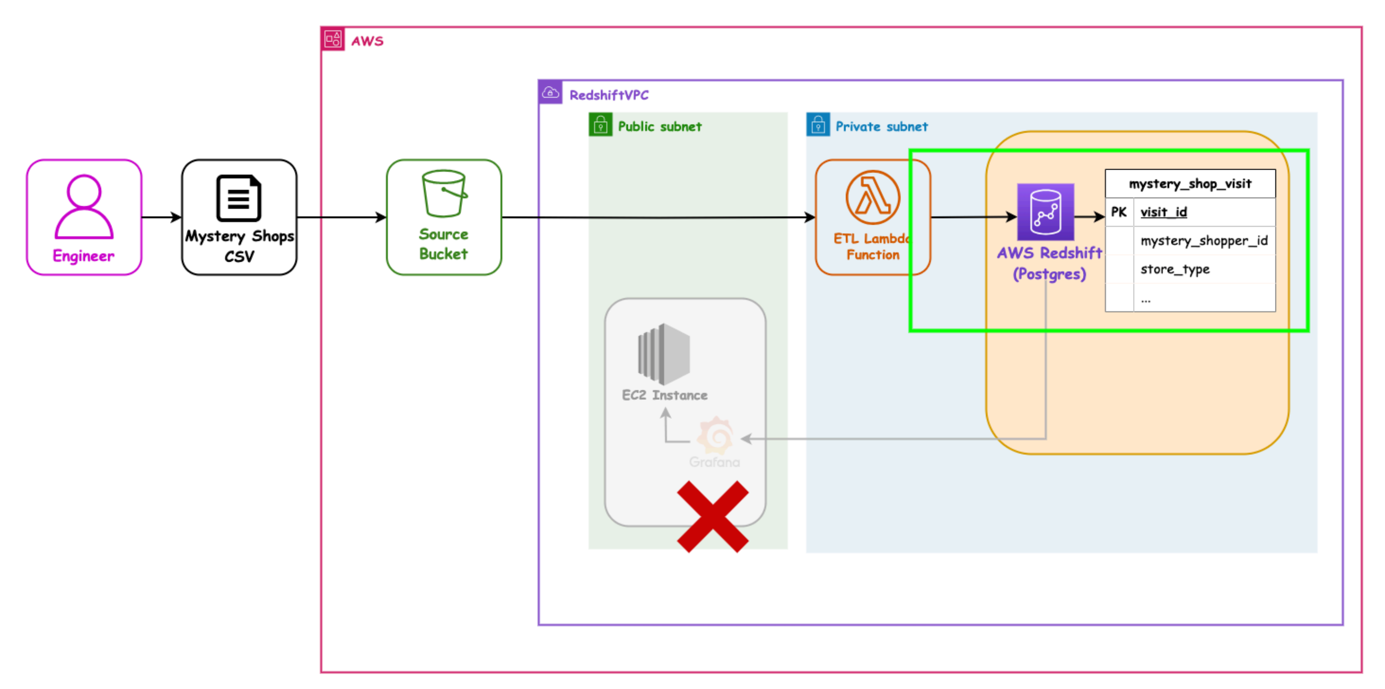
This is what the IaC has set up and allowed us to use:



| | mystery_shop_visit |
|---|---|
| PK | visit_id |
| | mystery_shopper_id |
| | store_type |
| | ... |

# Our next user story - Architecture

We nearly have the whole system set up now:



# Overview - recap

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# Further Reading

- **Redshift:** The AWS Data Warehouse service used to store and analyse large quantities of data
- AWS Docs - https://aws.amazon.com/redshift/

# Emoji Check:

On a high level, do you think you understand the main concepts of this session? Say so if not!

1. 😢 Haven't a clue, please help!
2. 🙁 I'm starting to get it but need to go over some of it please
3. 😐 Ok. With a bit of help and practice, yes
4. 🙂 Yes, with team collaboration could try it
5. 😀 Yes, enough to start working on it collaboratively