Welcome!

- We'll start in a moment :)
- We are recording tonight's event. We may plan to take screenshots for social media.
  - ***If you want to remain anonymous***, change your name & keep video off.
- We'll introduce the hosts and break in-between for Q/A.
- We will make some time for Q&A at the end of the presentation as well.
- You can come prepared with questions. And, feel free to take notes.
- Online event best practices:
  - Don't multitask. Distractions reduce your ability to remember concepts.
  - Mute yourself when you aren't talking.
  - We want the session to be interactive.
  - Feel free to unmute and ask questions in the middle of the presentation.
  - Turn on your video if you feel comfortable.
  - Disclaimer: Speaker doesn't knows everything!

Check out:

- Technical Tracks and Digital Events
- Get updates – join the Digital mailing list
- Give us your feedback – take the Survey

WOMEN WHO CODE®

WWCode Digital + **Backend**
Backend Study Group

July 15, 2021

WOMEN WHO CODE

Introduction & Agenda

- Welcome from WWCode!
- Our mission: Inspiring women to excel in technology careers.
- Our vision: A world where women are representative as technical executives, founders, VCs, board members and software engineers.

Prachi Shah
Senior Software Engineer @ Metromile

Madhurima Nath
Data Scientist @ Slalom

- What is Backend Engineering?
- **Insights into data engineering, data science and machine learning engineering**
  - **<u>Data engineering</u> [Part 1 of 2]**
    - + Introduction
    - + Similarities/Differences
    - + Day in a life of data engineer
    - + Tech stack
  - Data science and machine learning engineering [Part 2 of 2]

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Backend Engineering

- What is Backend Engineering?
- Design, build and maintain server-side web applications.
- Concepts: Client-server architecture, API, micro-service, database engineering, distributed systems, storage, performance, deployment, availability, monitoring, etc.

Software Design

- Defining the architecture, modules, interfaces and data.
- Solve a problem or build a product.
- Define the input, output, business rules, data schema.
- Design patterns solve common problems.
- 3 Types:
  - UI design: Data visualization and presentation.
  - Data design: Data representation and storage.
  - Process design: Validation, manipulation and storage of data.

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What is data engineering?

Data engineers

- **design and build pipelines** to transform and transport data into a format readily useable by the data scientists or other end users.
- pipelines take data from many disparate sources and collect them into a single warehouse that is the unified data source for others.
- work closely with **DevOps and data science/machine learning** teams

Data Engineer (DE) vs Data Scientist (DS) vs Machine Learning Engineer (MLE)

Data engineer:
builds and develops pipelines, and maintains of data infrastructure, either on-premises or in the cloud (or hybrid or multi-cloud), comprising of databases or data warehouses

Data scientist:
builds and develops mathematical and statistical models -- called machine learning models, to find patterns and gain more insights from the data

Machine learning engineer:
design architecture and pipelines (or software) to integrate and automate the process of running the models developed by data scientists with the entire infrastructure

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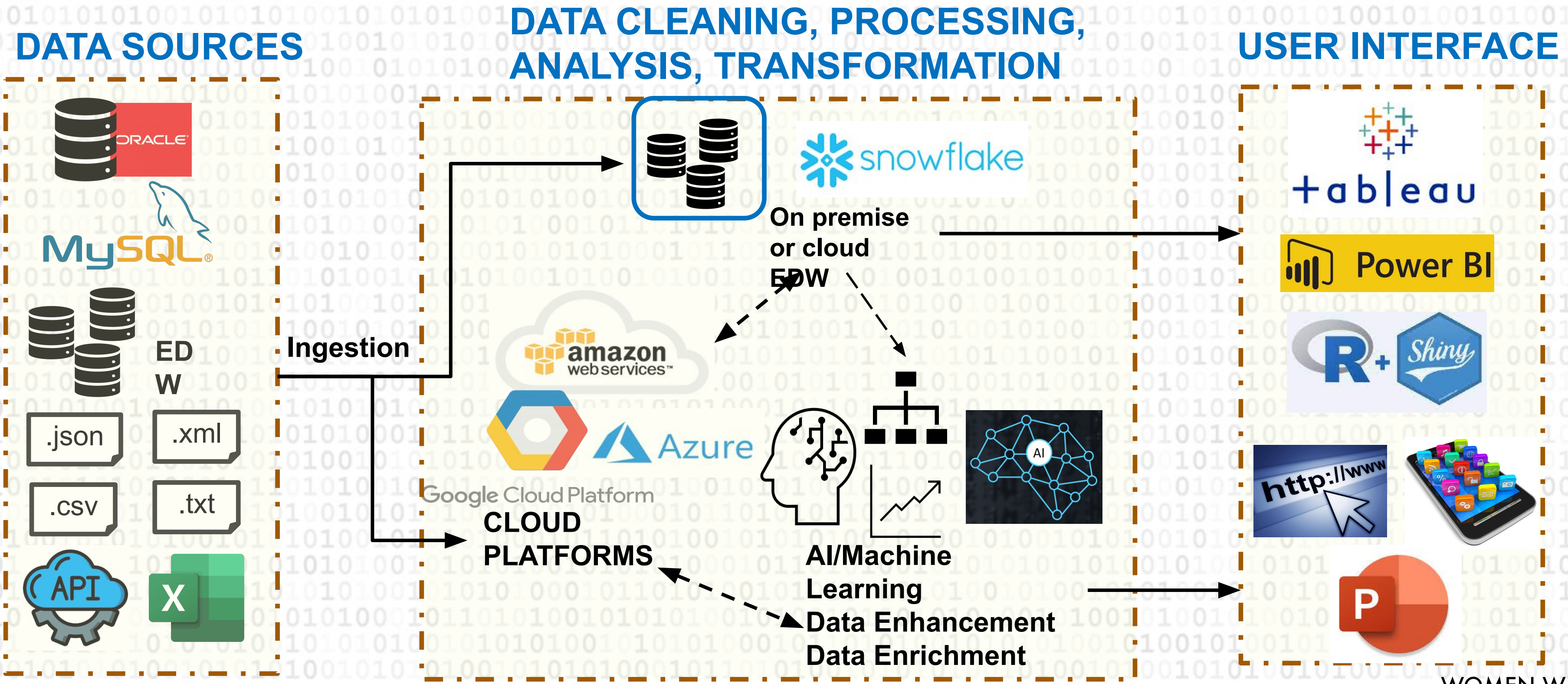
Data Architecture Diagram



DATA SOURCES

DATA CLEANING, PROCESSING, ANALYSIS, TRANSFORMATION

USER INTERFACE

ED W

Ingestion

On premise or cloud EDW

CLOUD PLATFORMS

AI/Machine Learning
Data Enhancement
Data Enrichment

Disclaimer: These can change based on companies/industry

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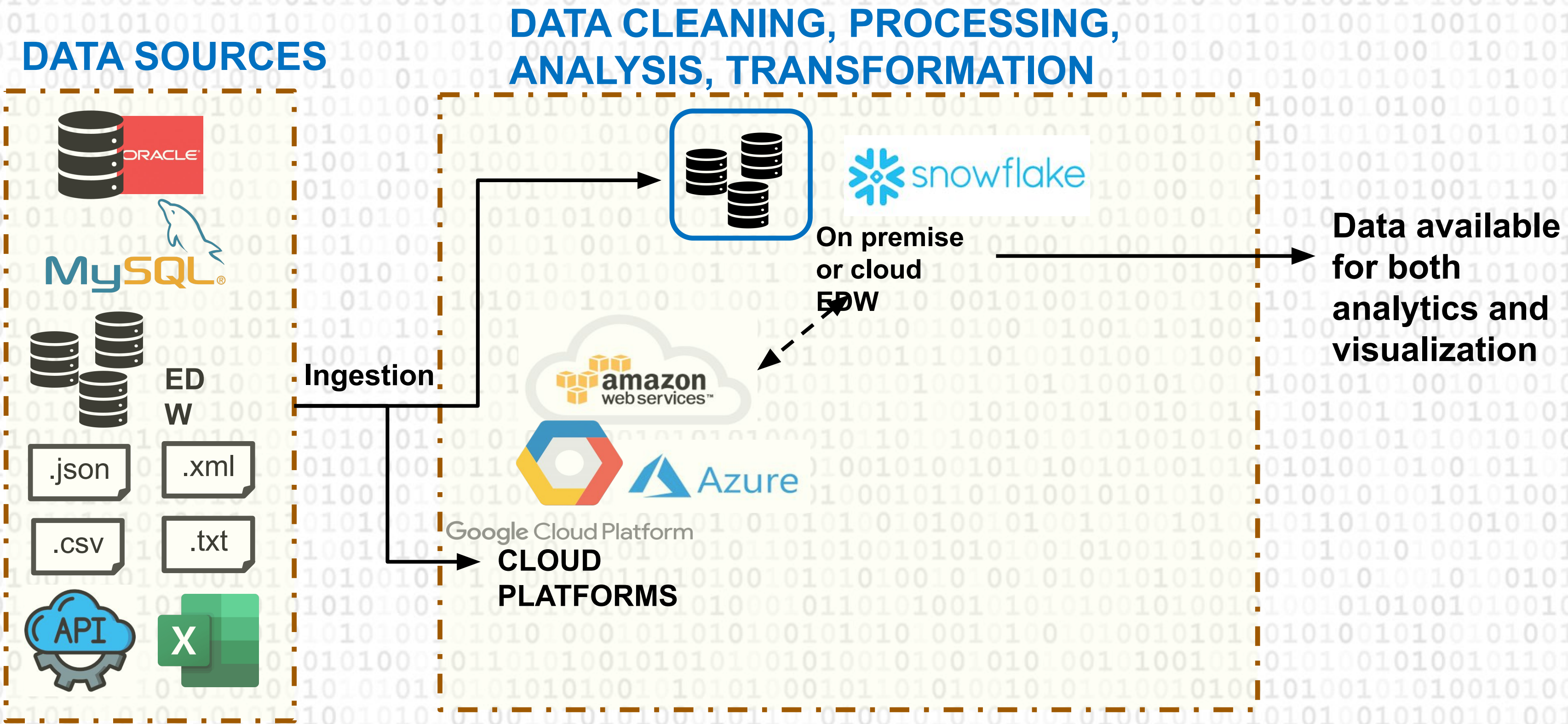
Data Architecture Diagram – Data Engineer



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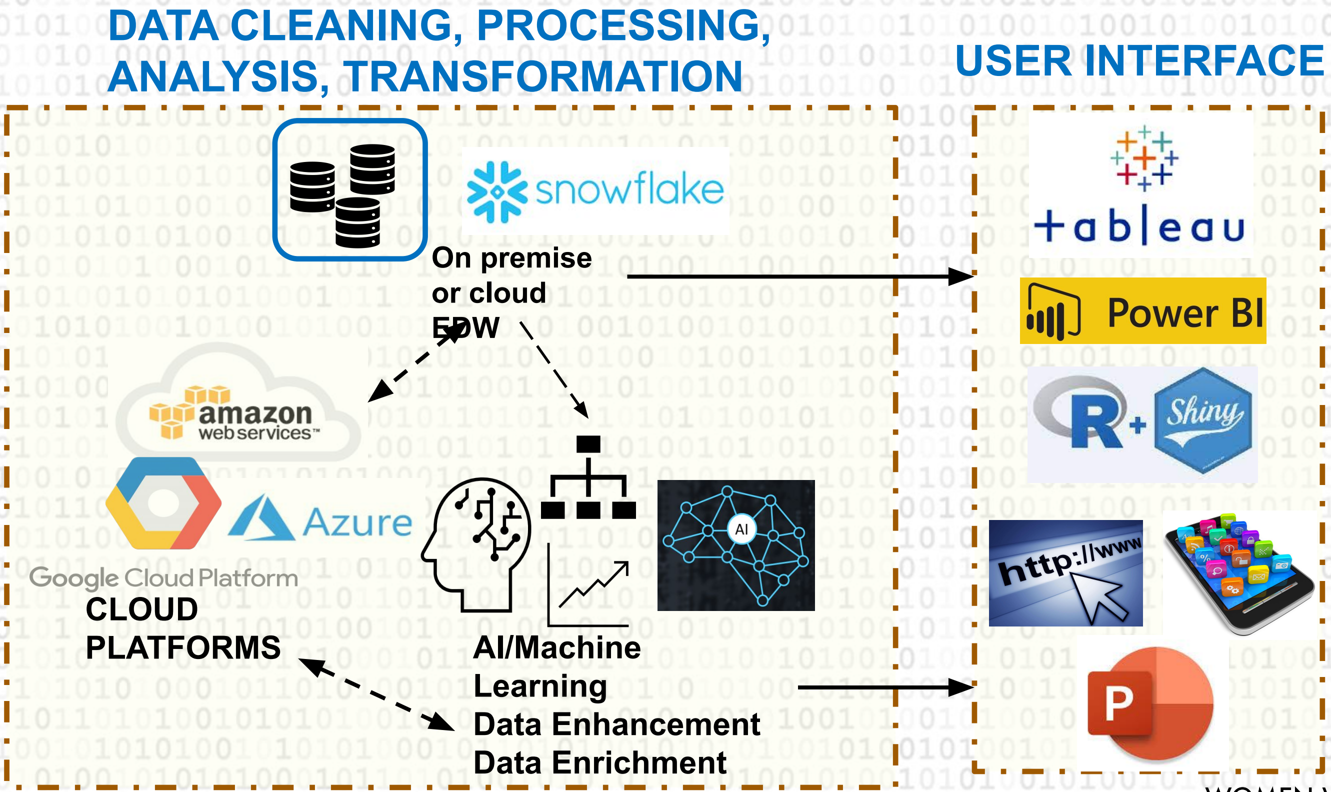
Data Architecture Diagram – Data Scientist



DATA CLEANING, PROCESSING, ANALYSIS, TRANSFORMATION

USER INTERFACE

On premise or cloud EDW

CLOUD PLATFORMS

AI/Machine Learning
Data Enhancement
Data Enrichment

Disclaimer: These can change based on companies/industry

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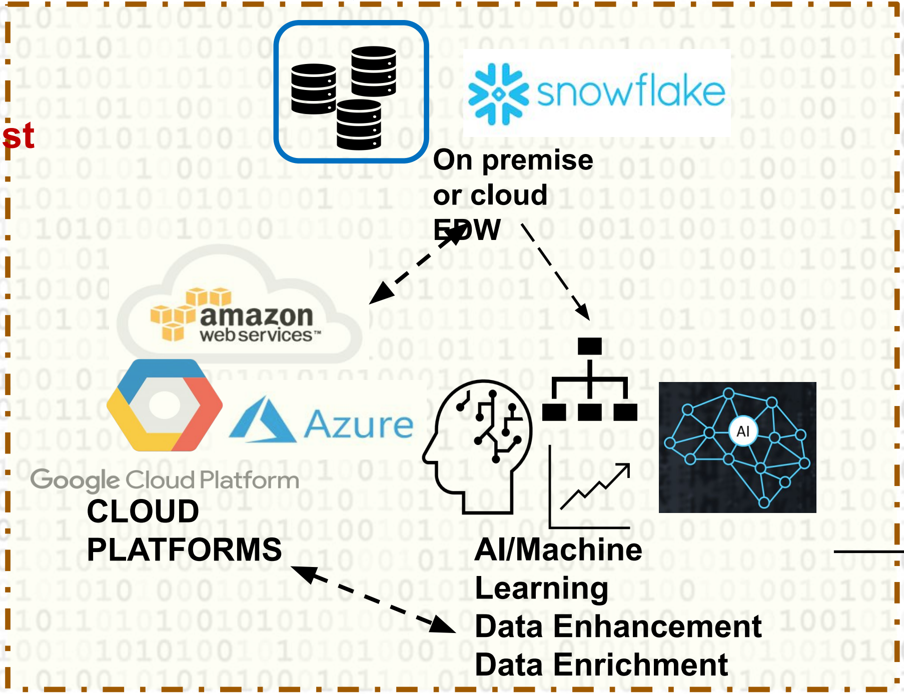
Data Architecture Diagram – ML Engineer

Automate and integrate with rest of the infrastructure



DATA CLEANING, PROCESSING, ANALYSIS, TRANSFORMATION

On premise or cloud EDW

CLOUD PLATFORMS

AI/Machine Learning
Data Enhancement
Data Enrichment

Data available for both analytics and visualization

Disclaimer: These can change based on companies/industry

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Who are Data Engineers (DE), Data Scientists (DS) and Machine Learning Engineers (MLE)?

You can unmute and talk or use the chat.

Data Engineer (DE) vs Data Scientist (DS) vs Machine Learning Engineer (MLE)

Data engineer:
- Develops data ingestion pipelines
- Takes data from multiple sources and in multiple formats and combines to single source

Data scientist:
- Finds patterns in the data to obtain insights
- Builds machine learning models to further enhance understanding of data

Machine learning engineer:
- Develops scripts to integrate work of data scientists with the larger framework
- Automates the work of data scientist such that models can be triggered to run without a data scientist

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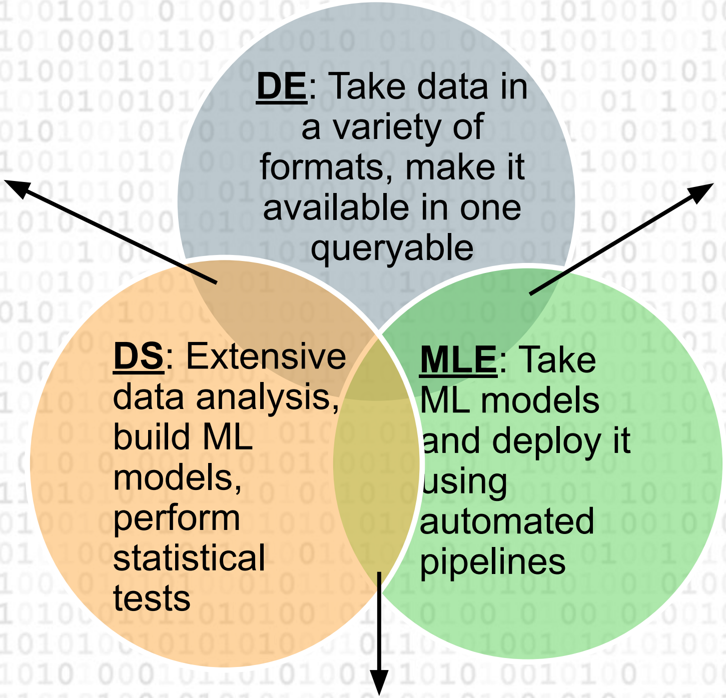
How do Data Engineers (DE), Data Scientists (DS) and Machine Learning Engineers (MLE) differ from each other?

You can unmute and talk or use the chat.

How they are different/similar?



DE: Take data in a variety of formats, make it available in one queryable

DS: Extensive data analysis, build ML models, perform statistical tests

MLE: Take ML models and deploy it using automated pipelines

- Data quality analysis
- SQL queries

- Integration of the pipelines with the overall architecture
- CI/CD

Test different ML models

Disclaimer: These can change based on companies/industry

NOTE

Data engineers, data scientists and machine learning engineers make use of existing/pre-built modules or libraries or functions.

They write their own functions or custom codes as well; however, not same as a software engineer or software developer.

Disclaimer: These can change based on companies/industry

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A Day in a Life of Data Engineer

Tasks:

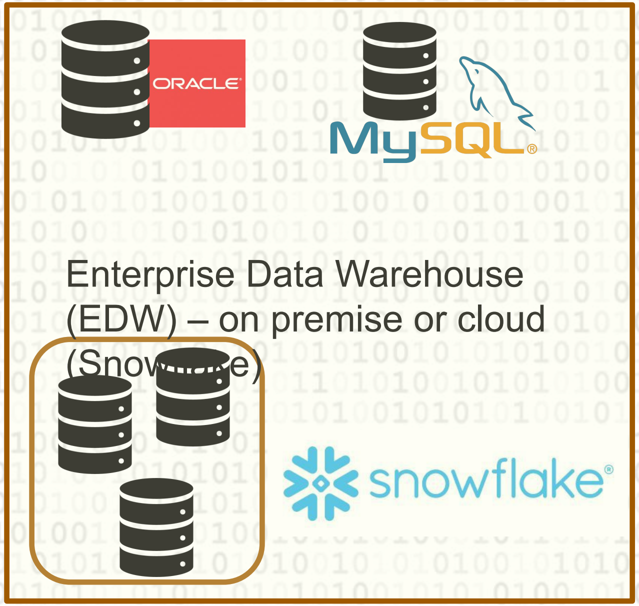
- make available in one place datasets ingested from a variety of sources in a variety of formats
- build the data pipelines to ingest streaming and batch data from many sources
- pipelines perform extract, transform, and load (ETL) processes to make the data more usable
- convert from row-oriented formats to column-oriented formats to facilitate analytical queries, partition data, index it, tag it, govern it, etc.

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

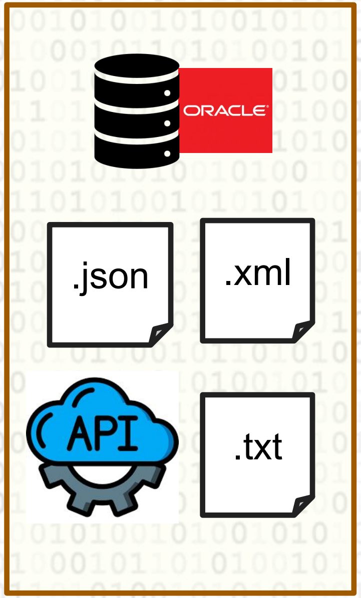
- make available in one place datasets ingested from a **variety of sources in a variety of formats**

INTERNAL

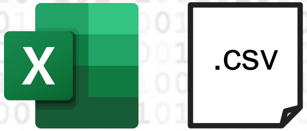


Enterprise Data Warehouse (EDW) – on premise or cloud (Snowflake)

EXTERNAL



INTERNAL



manual file sources

*API: Application Programming Interface: lets your product or service communicate with other products and services without having to know how they're implemented

Disclaimer: These can change based on companies/industry

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A Day in a Life of Data Engineer

- make available in one place datasets ingested from a **variety of sources in a variety of formats**

.txt

```
id name
age\n
01 ABCD
28\n
02 XYZ 39\n
…
…
```

.csv

```
id,name,age
01,ABCD,28
02,XYZ,39
…
…
```

.xml

```
<log date=May 01, 2021>
   <message id=1>
            <person id=01></person>
            <text> hi, how are you
</text>
            <time> May 01,
2021-16:09:22
            </time>
   <\message>
…
…
```

.json

```
{
“text”:“RT@abcland: my best day
..”,
“created_at”:“Fri Apr 15 10:05:45
            +0000 2020”,
“retweet_count”:0,
“id_str”:“561819028170009”,
“entities”: {
     “user_mentions”: [],
      “hashtags”: []
               }, ….
….
}
```

MySQL

ORACLE

Parquet

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A Day in a Life of Data Engineer

- make available in one place datasets ingested from a **variety of sources in a variety of formats**

.txt

```
id name
age\n
01 ABCD
28\n
02 XYZ 39\n
…
…
```

.csv

```
id,name,age
01,ABCD,28
02,XYZ,39
…
…
```

.xml

```
<log date=May 01, 2021>
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2021-16:09:22
            </time>
   <\message>
…
…
```

.json

```
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            +0000 2020”,
“retweet_count”:0,
“id_str”:“561819028170009”,
“entities”: {
     “user_mentions”: [],
      “hashtags”: []
             }, …
…
}
```

MySQL

ORACLE

Parquet

Can you identify which data formats are structured/unstructured/semi-structured?

You can unmute and talk or use the chat.

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A Day in a Life of Data Engineer

- make available in one place datasets ingested from a **variety of sources in a variety of formats**

.txt

```
id name
age\n
01 ABCD
28\n
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…
```

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```
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…
```

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```
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…
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```

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"entities": {
     "user_mentions": [],
      "hashtags": []
              }, ….
….
}
```

MySQL

ORACLE

Parquet

UNSTRUCTURED

SEMI-STRUCTURED

STRUCTURED

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A Day in a Life of Data Engineer

- make available in one place datasets ingested from a **variety of sources in a variety of formats**

.txt

```
id name
age\n
01 ABCD
28\n
02 XYZ 39\n
…
…
```

.csv

```
id,name,age
01,ABCD,28
02,XYZ,39
…
…
```

.xml

```
<log date=May 01, 2021>
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2021-16:09:22
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…
```

.json

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.. ,
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              +0000 2020",
"retweet_count":0,
"id_str":"561819028170009",
"entities": {
     "user_mentions": [],
      "hashtags": []
              }, ….
….
}
```

MySQL ORACLE

Parquet

Which data formats are more user-friendly?

Which data formats are more storage efficient?

You can unmute and talk or use the chat.

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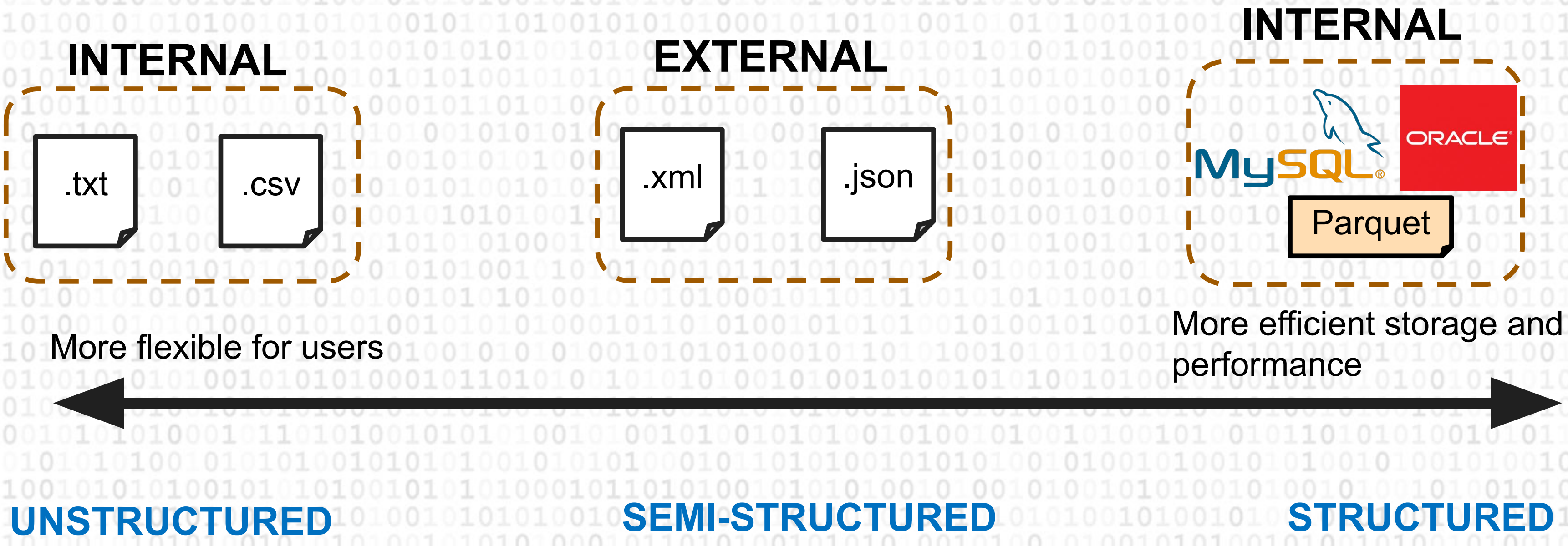
A Day in a Life of Data Engineer

- make available in one place datasets ingested from **a variety of sources in a variety of formats**



INTERNAL

.txt

.csv

EXTERNAL

.xml

.json

INTERNAL

MySQL

ORACLE

Parquet

More flexible for users

More efficient storage and performance

UNSTRUCTURED

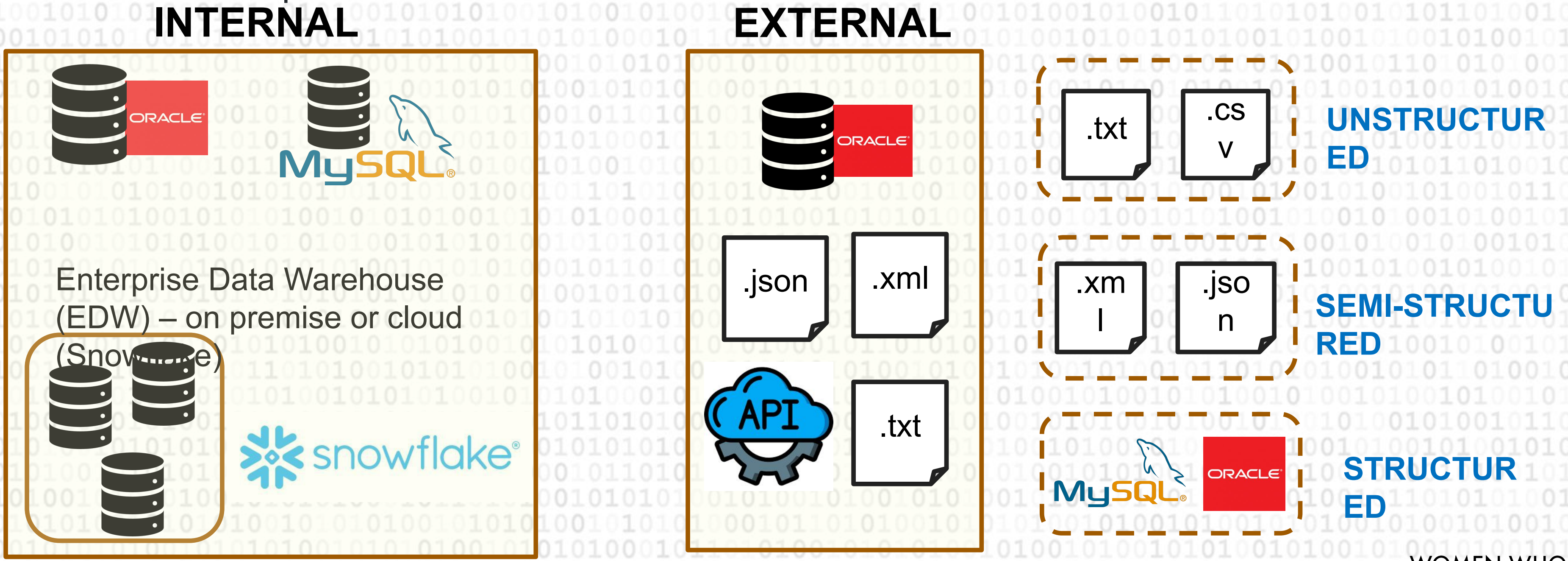
SEMI-STRUCTURED

STRUCTURED

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

- Ingest data **from internal and external** sources – could be **unstructured, semi-structured or structured** and make it available at one place



INTERNAL

Enterprise Data Warehouse (EDW) – on premise or cloud (Snowflake)

EXTERNAL

UNSTRUCTURED

SEMI-STRUCTURED

STRUCTURED

Disclaimer: These can change based on companies/industry

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A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Streaming data – real-time –
e.g.: log files generated by customers using your mobile or web applications, ecommerce purchases, in-game player activity, information from social networks, financial trading floors, or geospatial services.

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A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Streaming data – real-time –

e.g.: log files generated by customers using your mobile or web applications, ecommerce purchases, in-game player activity, information from social networks, financial trading floors, or geospatial services.

```
from pyspark import SparkContext
from pyspark.streaming import StreamingContext
```

→ **Calling pre-built spark functions**

```
sc = SparkContext(master, appName)
ssc = StreamingContext(sc, 1)
```

“appName”: name for your application
“master”: Spark/local compute node
“1”: interval of 1 second

(https://spark.apache.org/docs/latest/streaming-programming-guide.html)

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A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Batch data – not real-time –
e.g.: very large amounts of data when data sources are legacy systems, moving data from databases/data warehouse to cloud.

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A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Batch data – not real-time –
e.g.: very large amounts of data when data sources are legacy systems, moving data from databases/data warehouse to cloud.

```
# read data in csv format
spark.read.format("csv")
.option("mode", "FAILFAST")
.option("inferSchema", "true")
.option("path", "path/to/file(s)")
.schema(someSchema)
.load()
```

```
# write the data as parquet format
dataframe.write.format(“parquet”)
.option("mode", "OVERWRITE")
.option("dateFormat", "yyyy-MM-dd")
.option("path", "path/to/file(s)")
.save()
```

A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming (i.e., real-time) and batch data from many sources

Writing files/data

```
dataframe.write.format("csv")
.option("mode", "OVERWRITE")
.option("dateFormat", "yyyy-MM-dd")
.option("path", "path/to/file(s)")
.save()
```

Save modes –
append: add output to already existing file at the same location
overwrite: completely overwrite over existing data/file
errorIfExists: throw an error and fail if data/file already exists at the same location
ignore: do nothing, if data/file already exists

A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Streaming data – real-time –
e.g.: log files generated by customers using your mobile or web applications, ecommerce purchases, in-game player activity, information from social networks, financial trading floors, or geospatial services.

databricks

(https://databricks.com/blog/2016/07/28/structured-streaming-in-apache-spark.html)

```
# read data continuously from AWS S3 location
val inputDF = spark.readStream.json("s3://logs")
```

```
# write the data into MySQL database
inputDF.groupBy($"action", window($"time", "1 hour")).count()
    .writeStream.format("jdbc")
    .start("jdbc:mysql//…")
```

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Batch data – not real-time –
e.g.: very large amounts of data when data sources are legacy systems, moving data from databases/data warehouse to cloud.

```
# read data in JSON format from AWS S3 location
val inputDF = spark.read.json("s3://logs")
```

databricks
(https://databricks.com/blog/2016/07/28/structured-streaming-in-apache-spark.html)

```
# write the data into MySQL database
inputDF.groupBy($"action", window($"time", "1 hour")).count()
     .write.format("jdbc")
     .start("jdbc:mysql//…")
```

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A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Can you give examples of streaming and batch data?

You can unmute and talk or use the chat.

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A Day in a Life of Data Engineer

Tasks:

- build the data pipelines to ingest streaming and batch data from many sources

Examples of streaming data

- e-commerce data
- social media data
- financial trading data

Examples of streaming data

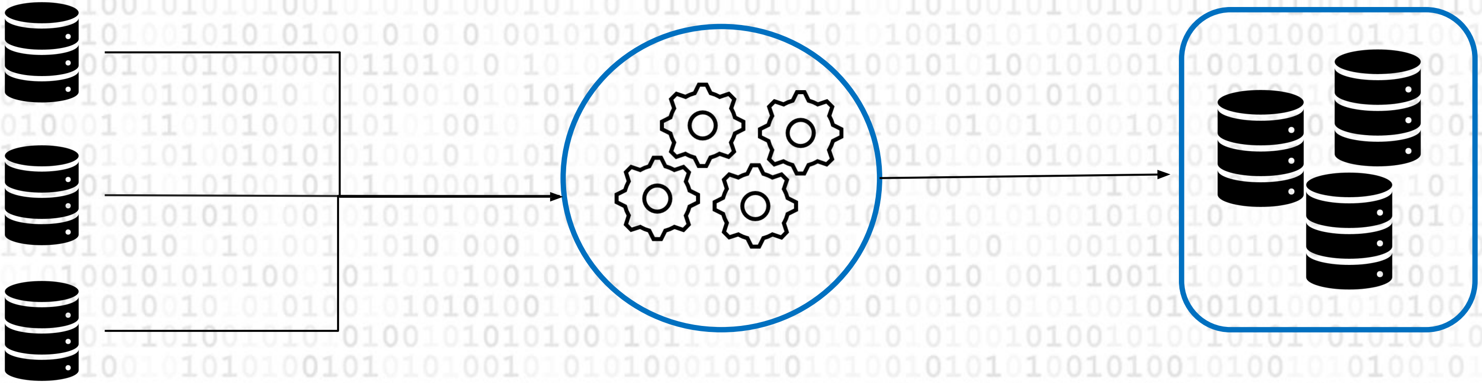
- data from Oracle/Postgres databases
- data from enterprise data warehouses (EDW)
- data from enterprise resource planning (ERP)

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes to make the data more usable

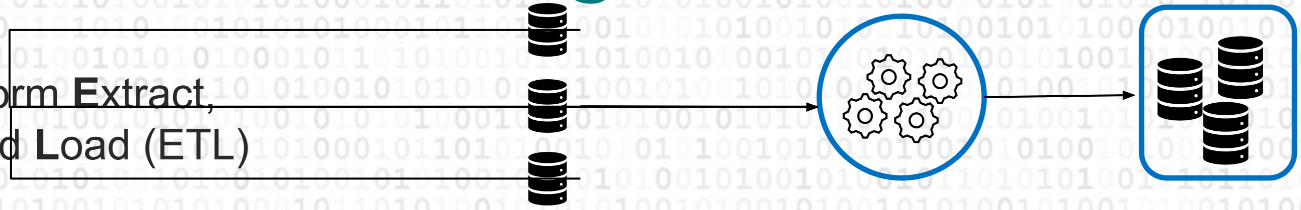
- Extract (E) – data from sources (databases)
- Transform (T) – data to match certain common defined format (for business purposes)
- Load (L) – load re-formatted data to data warehouse



A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Example:

Suppose you want to extract data from multiple databases and put it in cloud data storage.

How would you extract the data to load into cloud data storage?

You can unmute and talk or use the chat.

Disclaimer: These can change based on companies/industry

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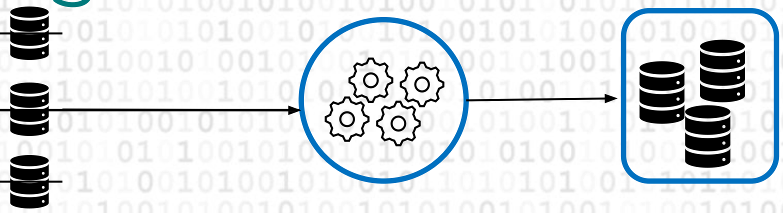
A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Example:

Suppose you want to extract data from multiple databases and put it in cloud data storage.

Step 1: How to handle day 0 load (everything that currently exist)?
Step 2: How to handle new incremental data?

Disclaimer: These can change based on companies/industry

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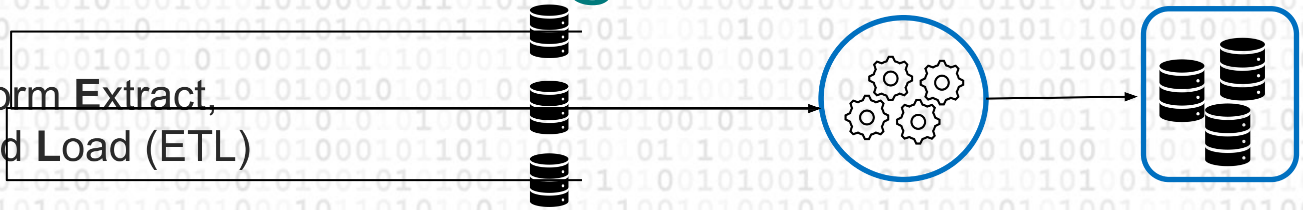
A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Example:

Suppose you want to extract data from multiple databases and put it in cloud data storage.

Step 1: Day 0 (already existing data) load

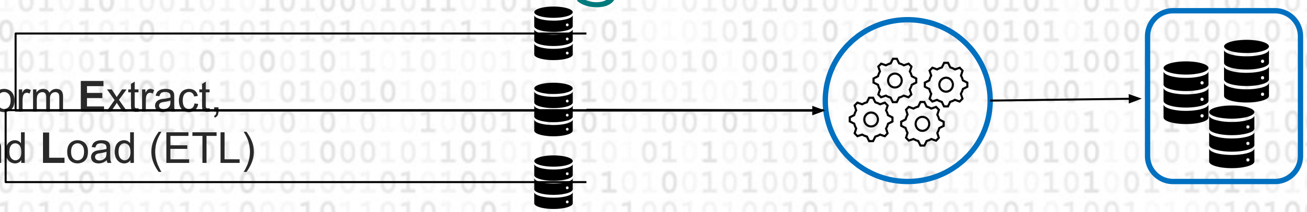
- Partition the data
- Keep track of the partitions
- Load the partitioned data

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Example:

Suppose you want to extract data from multiple databases and put it in cloud data storage.

Step 1: Day 0 (already existing data) load
Step 2: New incremental data load
- decide on the frequency (daily/weekly/monthly)
- refresh the tables with new data

Disclaimer: These can change based on companies/industry

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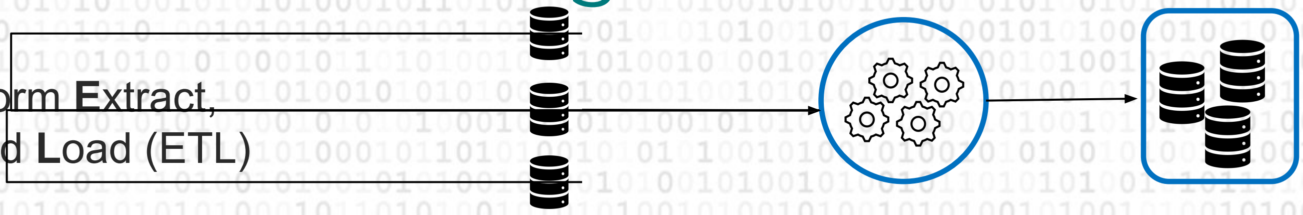
A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Example:

Suppose you want to extract data from multiple databases and put it in cloud data storage. (Code for Azure data storage on Databricks)

```
table_id = dbutils.widgets.get(“table_id”)                              □ get source table id from source
job_id = dbutils.widgets.get(“job_id”)                                  □ get job id

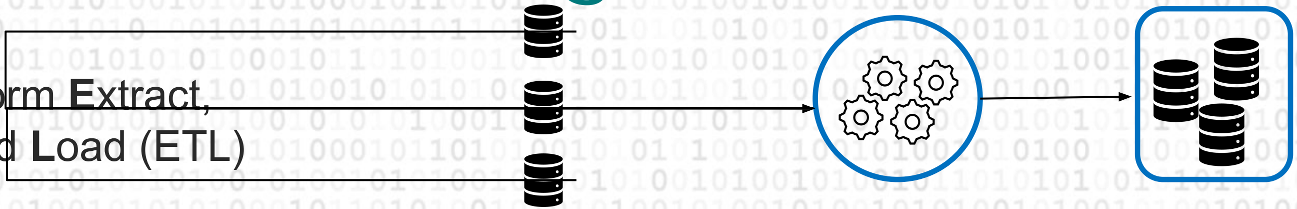
storageCfg =DatalakeStorageConfig()                                     □ load configuration of cloud storage
storageCfgPath = ConfigLoader(DatalakeStorageConfig().cfg_path)         □ load configuration path of cloud storage
```

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Example:

Suppose you want to extract data from multiple databases and put it in cloud data storage. (Code for Azure data storage on Databricks)

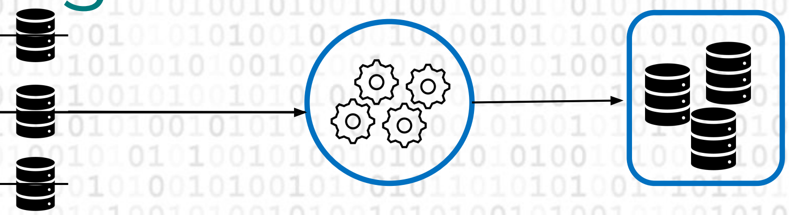
```
table_name = storageCfgPath.get_dataset_by_id(table_id).table_name          □ set destination table name
table_folder = storageCfgPath.get_dataset_by_id(table_id).folder_name       □ set destination table folder
source_path = f'/../{storageCfg.root_dir}/../{table_folder}'           □ set source table path as parametrized path
dest_path = f'/../{storageCfg.root_dir}/../{table_folder}'             □ set target table path as parametrized path
```

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



```
import json
from pyspark.sql.types import *
from pyspark.sql import functions as F
```

→ **Call pre-built python and spark functions**

```
source_df = spark.read.format('parquet)
     .load(source_path).filter(F.col('job_id) == job_id)

if source_df.count() > 0:
      ( source_df.write.format('format').mode('merge').partitionBy('job_id').save(source_path) )
      try:
     sqlCmd = 'CREATE TABLE IF NOT EXISTS table' + table_name + " USING LOCATION '{}'"
            .format(dest__path)
     spark.sql(sqlCmd)
      except:
     OSError as e
```

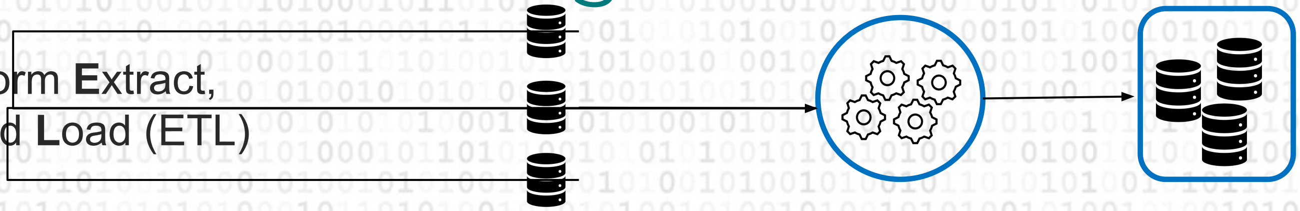
Disclaimer: These can change based on companies/industry

WOMEN WHO CODE

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



```
import json
from pyspark.sql.types import *
from pyspark.sql import functions as F
```

Call pre-built python and spark functions

```
source_df = spark.read.format(‘parquet)
      .load(source_path).filter(F.col(‘job_id) == job_id)
```

Read batch files (format – parquet)
Filter these files with job id

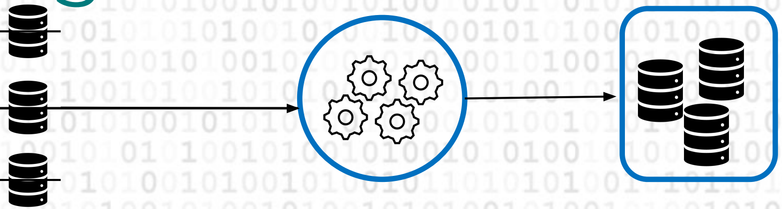
```
if source_df.count() > 0:
    ( source_df.write.format(‘format’).mode(‘merge’).partitionBy(‘job_id’).save(source_path) )
    try:
  sqlCmd = ‘CREATE TABLE IF NOT EXISTS table’ + table_name + “ USING LOCATION ‘{}’“
        .format(dest__path)
  spark.sql(sqlCmd)
    except:
  OSError as e
```

Disclaimer: These can change based on companies/industry

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



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  OSError as e
```

Save data to defined path
Create table if table doesn’t exist at defined location

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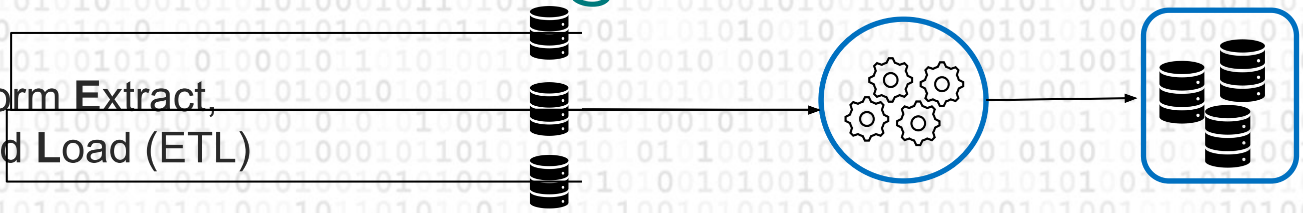

How would you handle streaming data? What would be the steps?

You can unmute and talk or use the chat.

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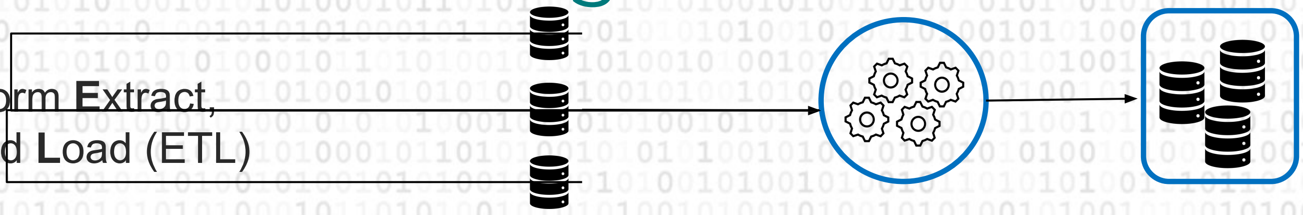
WOMEN WHO CODE

A Day in a Life of Data Engineer

Tasks:

- pipelines perform **E**xtract, **T**ransform, and **L**oad (ETL) processes



Streaming data

Step 1: Day 0 load – historical data load
- partition the data
- load the partitioned data

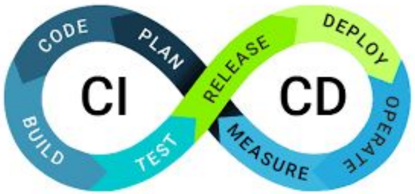
Step 2: Real-time incremental data
- decide on the frequency of refresh – seconds/minutes/hours
- refresh data in the tables

Disclaimer: These can change based on companies/industry

WOMEN WHO CODE

Tech stack for data engineers

Languages: **SQL, NoSQL, Python**, Java, Scala
Spark, Databricks, Kafka, Hadoop, CI/CD* framework



*CI/CD: Continuous Integration Continuous Deployment

Disclaimer: These can change based on companies/industry

Backend Study Group

- WWCode Presentation and Demo
- WWCode YouTube channel for session recordings.

Resources:

spark documentation
databricks documentation
snowflake documentation
azure data engineer certification course
google cloud data engineer certification course
aws big data certification
Udacity data engineering interview questions

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