Extract

INTRODUCTION TO DATA ENGINEERING

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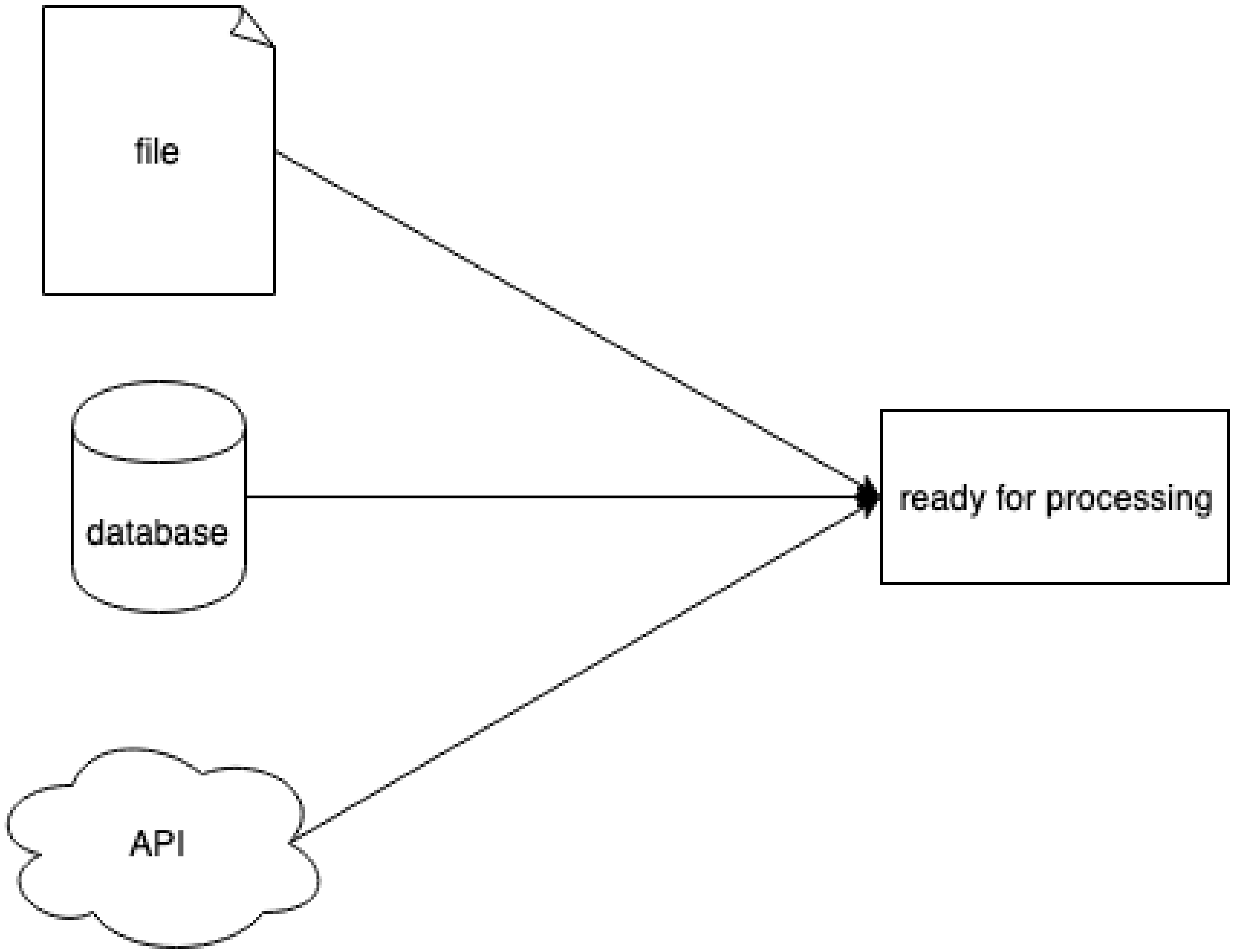
Extracting data: what does it mean?



Extract from text files

Unstructured

- Plain text
- E.g. chapter from a book

```
Call me Ishmael. Some years ago—never
mind how long precisely—having little or
no money in my purse, and nothing particular
to interest me on shore, I thought ....
```

Flat files

- Row = record
- Column = attribute
- E.g. `.tsv` or `.csv`

```
Year,Make,Model,Price
1997,Ford,E350,3000.00
1999,Chevy,"Venture Extended Edition",4900.00
1999,Chevy,"Venture Extended Edition",5000.00
1996,Jeep,Grand Cherokee,4799.00
```

JSON

- JavaScript Object Notation
- Semi-structured
- Atomic
  - `number`
  - `string`
  - `boolean`
  - `null`
- Composite
  - `array`
  - `object`

```
{
  "an_object": {
    "nested": [
      "one",
      "two",
      "three",
      {
        "key": "four"
      }
    ]
  }
}
```

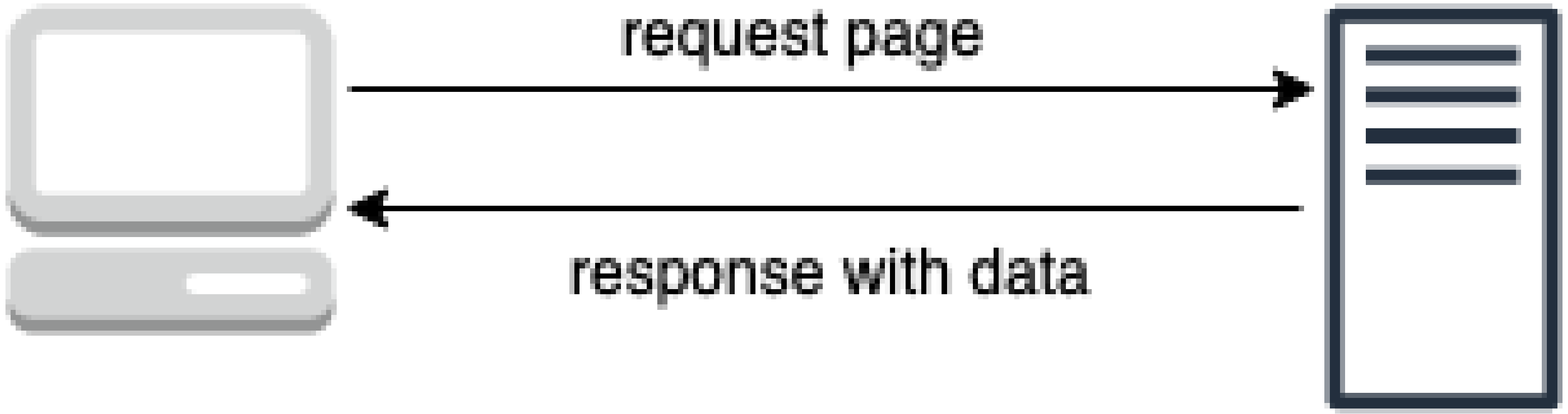
```python
import json
result = json.loads('{"key_1": "value_1",
                      "key_2":"value_2"}')

print(result["key_1"])
```

```
value_1
```

Data on the Web

Requests



Example

1. *Browse to Google*
2. *Request to Google Server*
3. *Google responds with web page*

Data on the Web through APIs

- Send data in JSON format
- API: application programming interface
- Examples
  - Twitter API


```
{ "statuses": [{ "created_at": "Mon May 06 20:01:29 +0000 2019", "text": "this is a tweet"}] }
```


- Hackernews API

```python
import requests

response = requests.get("https://hacker-news.firebaseio.com/v0/item/16222426.json")
print(response.json())
```


```
{'by': 'neis', 'descendants': 0, 'id': 16222426, 'score': 17, 'time': 1516800333, 'title': .... }
```

Data in databases

Applications databases

- Transactions
- Inserts or changes
- OLTP
- Row-oriented

Analytical databases

- OLAP
- Column-oriented

Extraction from databases

Connection string/URI

```
postgresql://[user[:password]@][host][:port]
```

Use in Python

```python
import sqlalchemy
connection_uri = "postgresql://repl:password@localhost:5432/pagila"
db_engine = sqlalchemy.create_engine(connection_uri)

import pandas as pd
pd.read_sql("SELECT * FROM customer", db_engine)
```

Let's practice!

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Transform

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Kind of transformations

customer_id	email	state	created_at
1	jane.doe@theweb.com	New York	2019-01-01 07:00:00

- Selection of attribute (e.g. 'email')
- Translation of code values (e.g. 'New York' -> 'NY')
- Data validation (e.g. date input in 'created_at')
- Splitting columns into multiple columns
- Joining from multiple sources

An example: split (Pandas)

customer_id	email	username	domain
1	jane.doe@theweb.com	jane.doe	theweb.com

```
customer_df # Pandas DataFrame with customer data

# Split email column into 2 columns on the '@' symbol
split_email = customer_df.email.str.split("@", expand=True)
# At this point, split_email will have 2 columns, a first
# one with everything before @, and a second one with
# everything after @

# Create 2 new columns using the resulting DataFrame.
customer_df = customer_df.assign(
  username=split_email[0],
  domain=split_email[1],
)
```

Transforming in PySpark

Extract data into PySpark

```
import pyspark.sql

spark = pyspark.sql.SparkSession.builder.getOrCreate()

spark.read.jdbc("jdbc:postgresql://localhost:5432/pagila",
                "customer",
                properties={"user":"repl","password":"password"})
```

An example: join

A new ratings table

customer_id	film_id	rating
1	2	1
2	1	5
2	2	3
...	...	...

The customer table

customer_id	first_name	last_name	...
1	Jane	Doe	...
2	Joe	Doe	...
...	...	...	...

`customer_id` **overlaps with ratings table**

An example: join (PySpark)

```
customer_df # PySpark DataFrame with customer data
ratings_df # PySpark DataFrame with ratings data

# Groupby ratings
ratings_per_customer = ratings_df.groupBy("customer_id").mean("rating")

# Join on customer ID
customer_df.join(
  ratings_per_customer,
  customer_df.customer_id==ratings_per_customer.customer_id
)
```

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Loading

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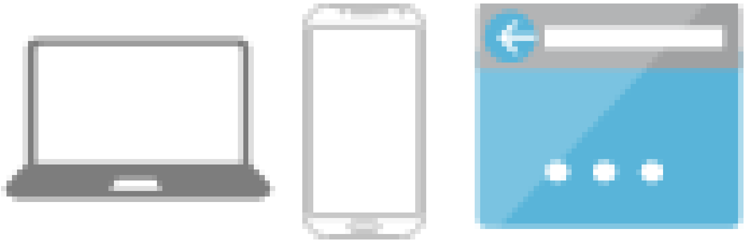
Analytics or applications databases

Analytics

- Aggregate queries
- Online analytical processing (OLAP)

Applications



- Lots of transactions
- Online transaction processing (OLTP)

Column- and row-oriented

Analytics

- Column-oriented

name	diameter (cm)	weight (g)
apple	10	100
grape	2	10

- Queries about subset of columns
- Parallelization

Applications

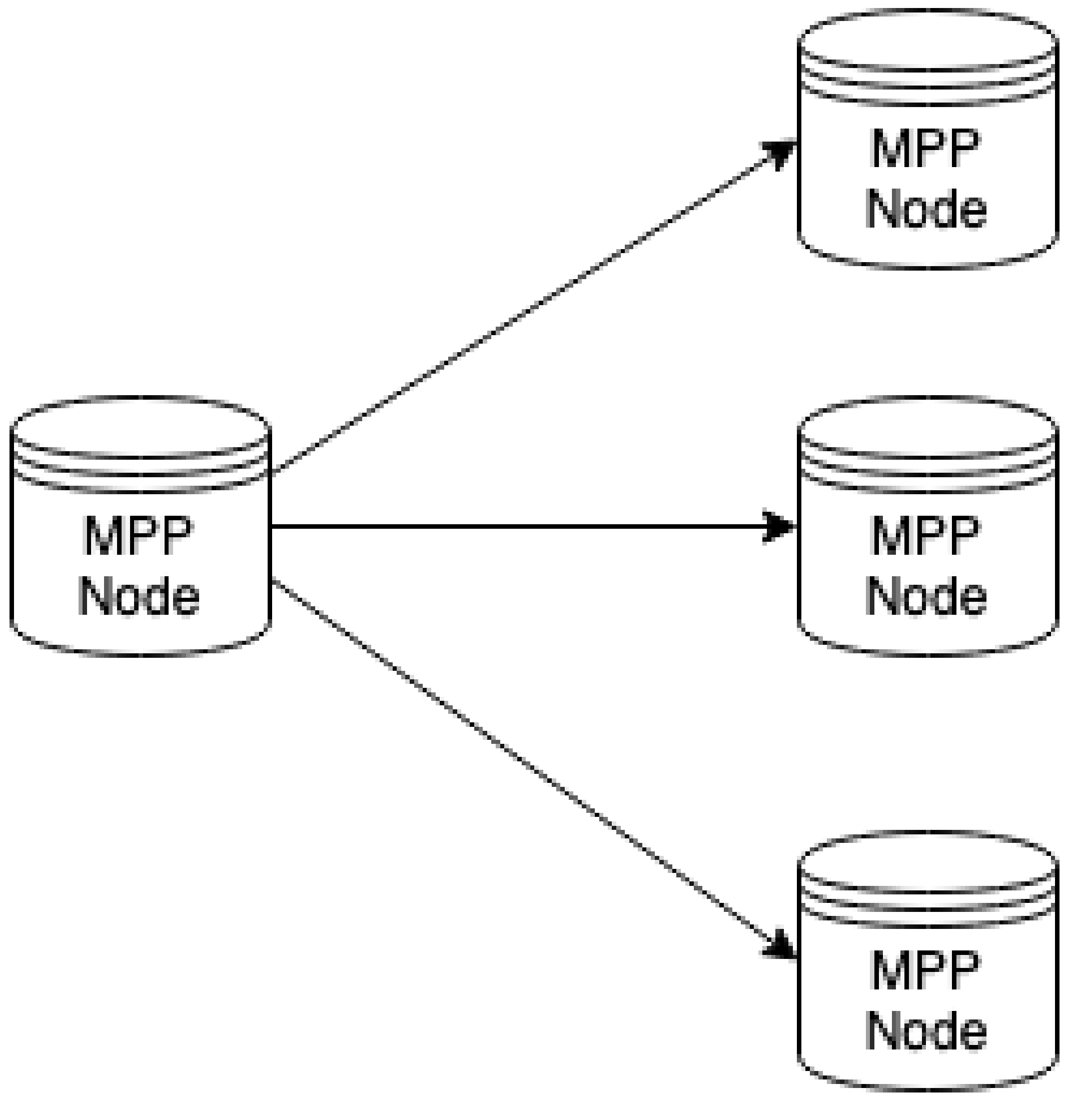
- Row-oriented

name	diameter (cm)	weight (g)
apple	10	100
grape	2	10

- Stored per record
- Added per transaction
- E.g. adding customer is fast

MPP Databases

Massively Parallel Processing Databases



- Amazon Redshift
- Azure SQL Data Warehouse
- Google BigQuery

An example: Redshift

Load from file to columnar storage format

```python
# Pandas .to_parquet() method
df.to_parquet("./s3://path/to/bucket/customer.parquet")
# PySpark .write.parquet() method
df.write.parquet("./s3://path/to/bucket/customer.parquet")
```

```sql
COPY customer
FROM 's3://path/to/bucket/customer.parquet'
FORMAT as parquet
...
```

Load to PostgreSQL

`pandas.to_sql()`

```
# Transformation on data
recommendations = transform_find_recommendatins(ratings_df)

# Load into PostgreSQL database
recommendations.to_sql("recommendations",
                       db_engine,
                       schema="store",
                       if_exists="replace")
```

Let's practice!

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Putting it all together

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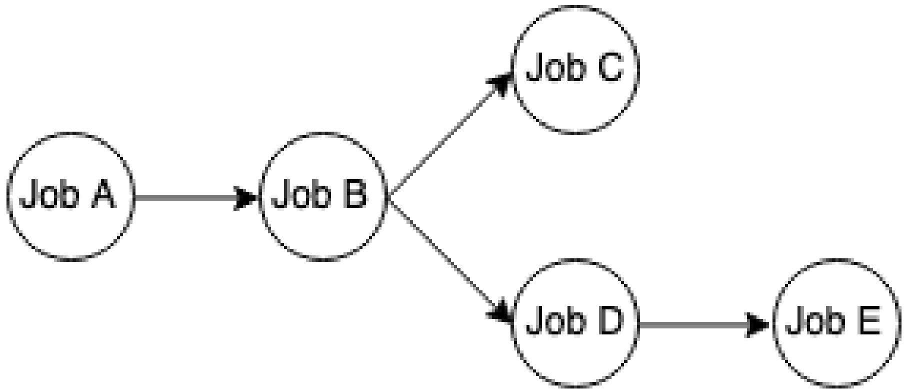
The ETL function

```
def extract_table_to_df(tablename, db_engine):
  return pd.read_sql("SELECT * FROM {}".format(tablename), db_engine)

def split_columns_transform(df, column, pat, suffixes):
  # Converts column into str and splits it on pat...

def load_df_into_dwh(film_df, tablename, schema, db_engine):
  return pd.to_sql(tablename, db_engine, schema=schema, if_exists="replace")

db_engines = { ... } # Needs to be configured
def etl():
  # Extract
  film_df = extract_table_to_df("film", db_engines["store"])
  # Transform
  film_df = split_columns_transform(film_df, "rental_rate", ".", ["_dollar", "_cents"])
  # Load
  load_df_into_dwh(film_df, "film", "store", db_engines["dwh"])
```

Airflow refresher

- Workflow scheduler
- Python
- DAGs



- Tasks defined in operators (e.g. `BashOperator`)

Scheduling with DAGs in Airflow

```
from airflow.models import DAG

dag = DAG(dag_id="sample",
          ...,
          schedule_interval="0 0 * * *")
```

```
# cron
# .------------------------- minute          (0 - 59)
# | .----------------------- hour            (0 - 23)
# | | .--------------------- day of the month (1 - 31)
# | | | .------------------- month           (1 - 12)
# | | | | .----------------- day of the week  (0 - 6)
# * * * * * <command>

# Example
0 * * * * # Every hour at the 0th minute
```

cf. **https://crontab.guru**

The DAG definition file

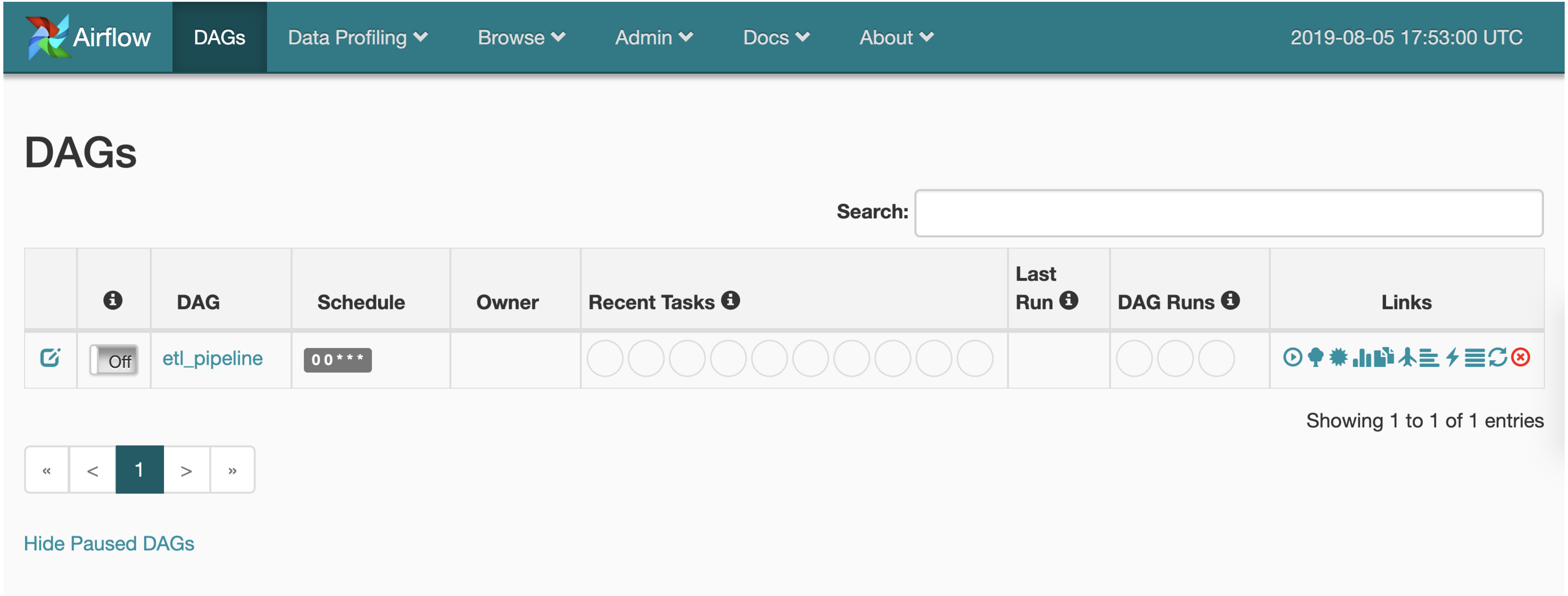
```
from airflow.models import DAG
from airflow.operators.python_operator import PythonOperator

dag = DAG(dag_id="etl_pipeline",
          schedule_interval="0 0 * * *")

etl_task = PythonOperator(task_id="etl_task",
                          python_callable=etl,
                          dag=dag)

etl_task.set_upstream(wait_for_this_task)
```

The DAG definition file

```
from airflow.models import DAG
from airflow.operators.python_operator import PythonOperator

...

etl_task.set_upstream(wait_for_this_task)
```

Saved as `etl_dag.py` in `~/airflow/dags/`

Airflow UI



Airflow
DAGs
Data Profiling
Browse
Admin
Docs
About
2019-08-05 17:53:00 UTC
DAGs
Search:
DAG
Schedule
Owner
Recent Tasks
Last Run
DAG Runs
Links
Off
etl_pipeline
0 0 * * *
Showing 1 to 1 of 1 entries
1
Hide Paused DAGs

Let's practice!

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