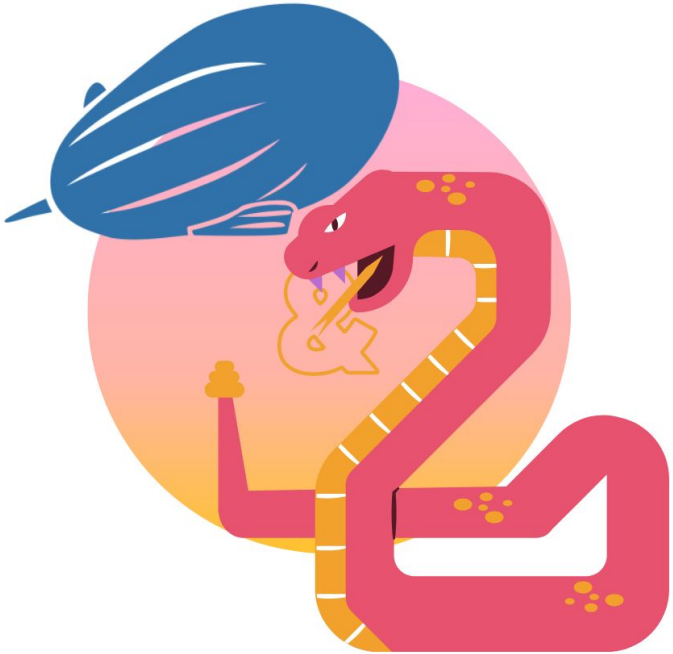


Interactive Data Exploration

With PyFlink and Zeppelin Notebooks

Marta Paes (@morsapaes)
Developer Advocate

ververica

About Ververica

Original Creators of
Apache Flink®

Enterprise Stream Processing
With Ververica Platform

Part of
Alibaba Group

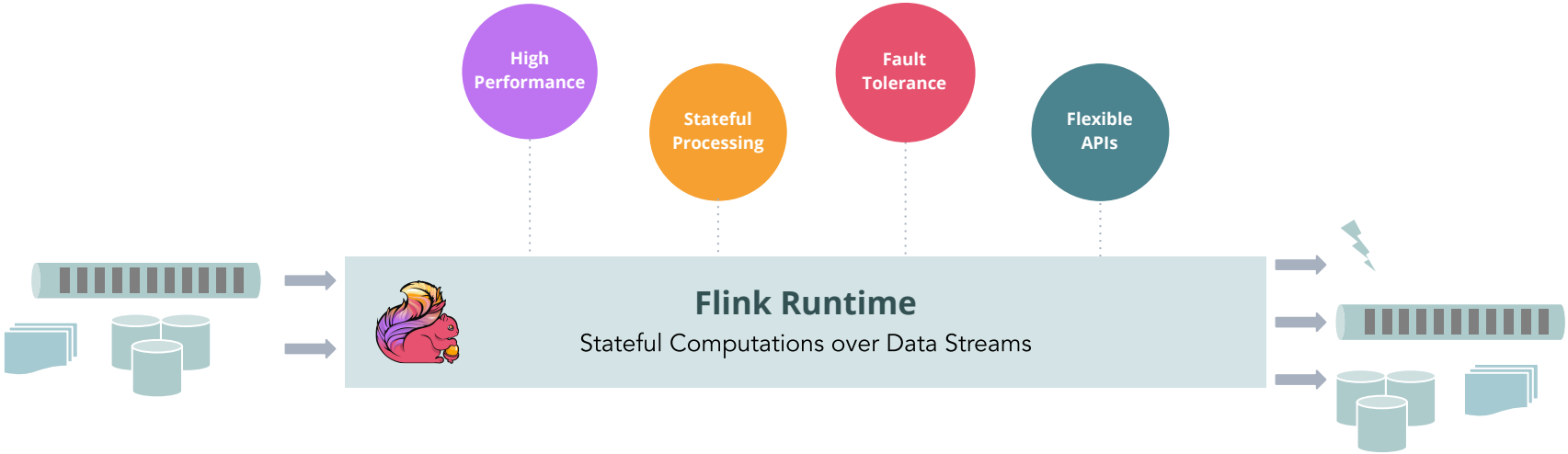
Apache Flink

Flink is an **open source** framework and **distributed** engine for **stateful stream processing**.

Learn more: flink.apache.org

Apache Flink

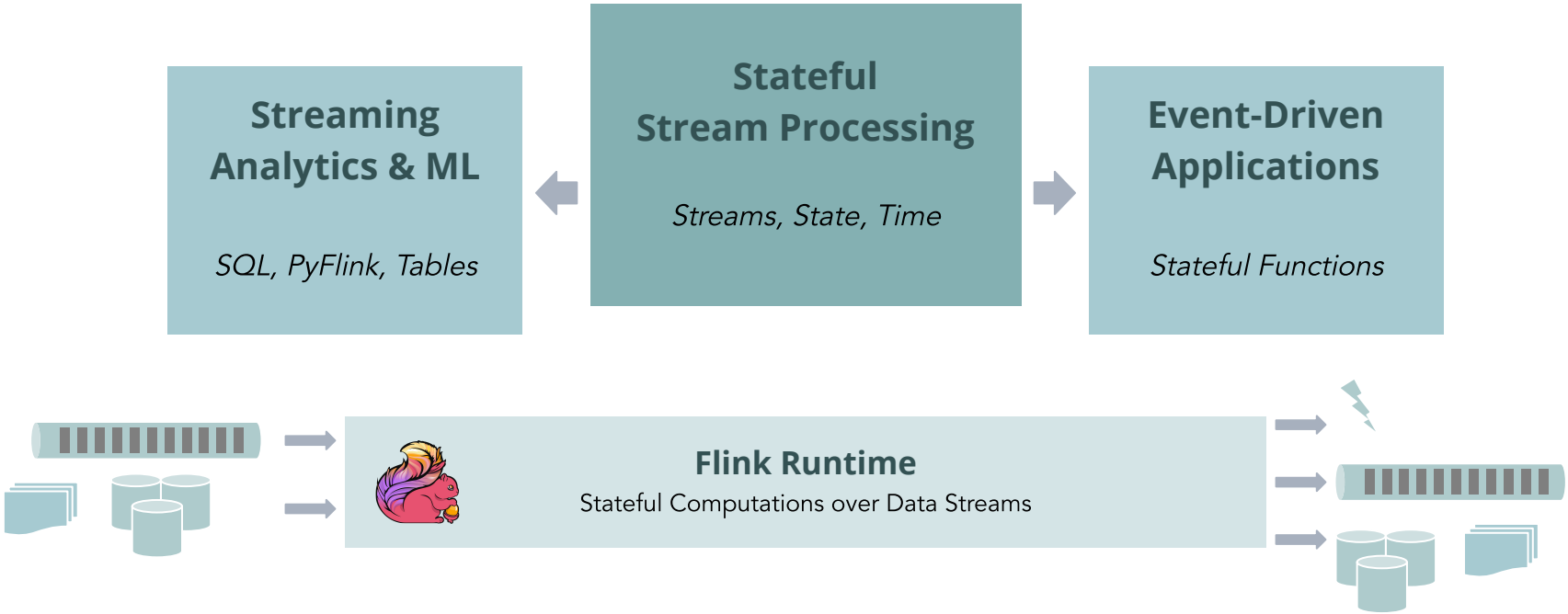
Flink is an **open source** framework and **distributed** engine for **stateful stream processing**.



Learn more: flink.apache.org

Use Cases

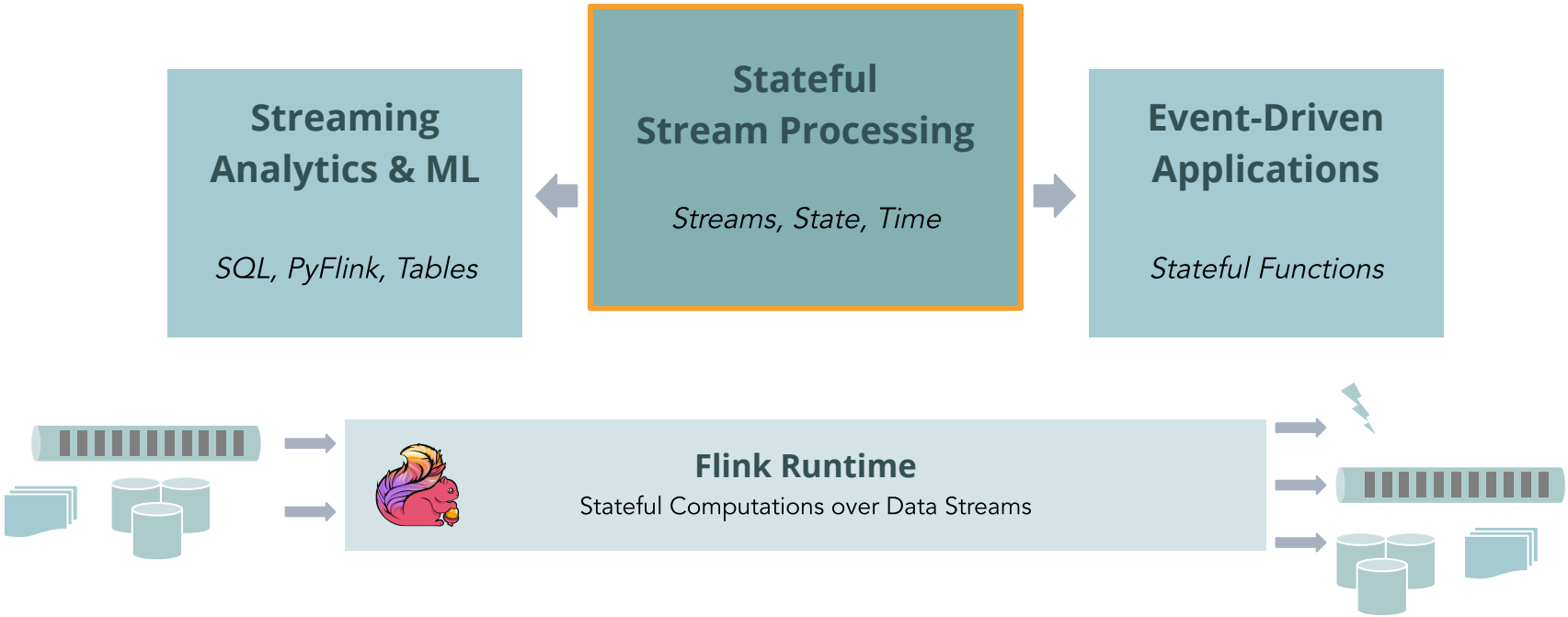
This gives you a robust foundation for a wide range of use cases:



Learn more: flink.apache.org

Use Cases

Classical, core stream processing use cases that build on the primitives of **streams**, **state** and **time**.



Learn more: flink.apache.org

Stateful Stream Processing

Classical, core stream processing use cases that build on the primitives of **streams**, **state** and **time**.

- Explicit control over these primitives
- Complex computations and customization
- Maximize **performance** and **reliability**

Example Use Cases

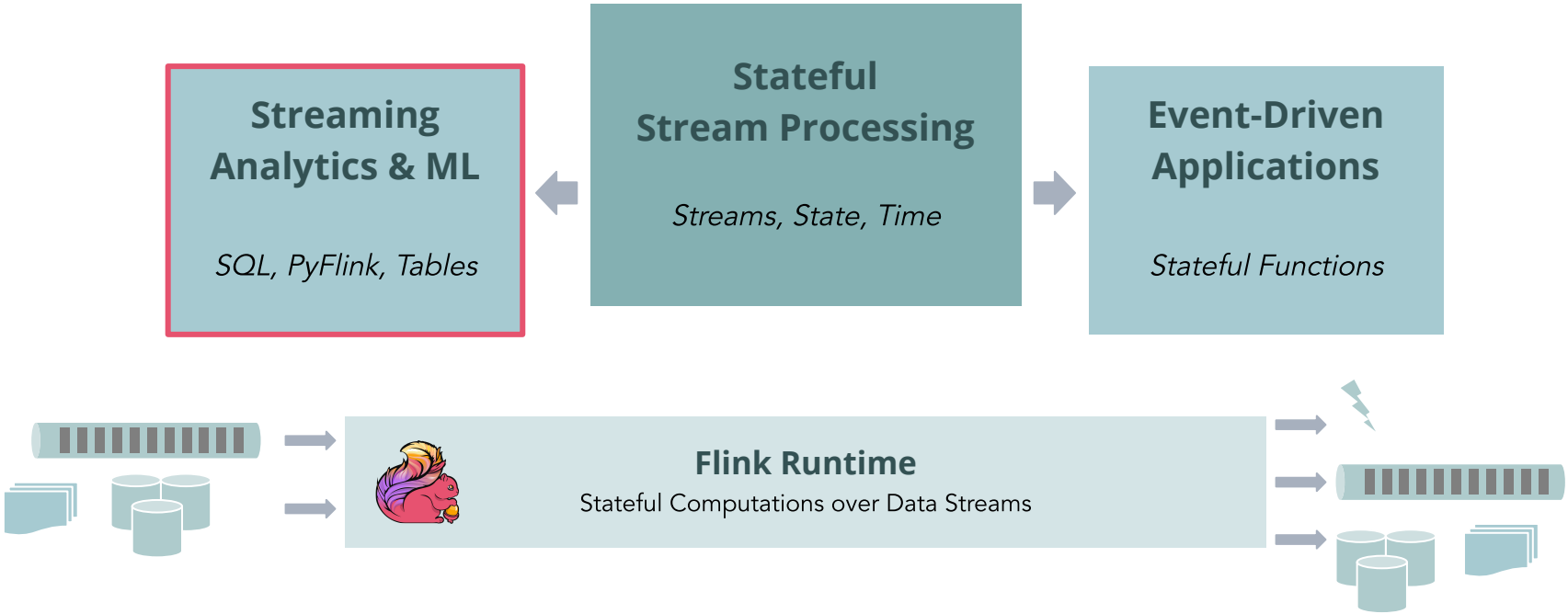
NETFLIX

aws

Large-scale Data Pipelines	ML-Based Fraud Detection	Service Monitoring & Anomaly Detection

Use Cases

More high-level or domain-specific use cases that can be modeled with SQL or Python and dynamic tables.



Learn more: flink.apache.org

Streaming Analytics & ML

More high-level or domain-specific use cases that can be modeled with SQL or Python and dynamic tables.

- Focus on logic, not implementation
- Mixed workloads (batch and streaming)
- Maximize **developer speed** and **autonomy**

Example Use Cases

Uber

criteo

Unified Online/Offline Model Training	E2E Streaming Analytics Pipelines	ML Feature Generation

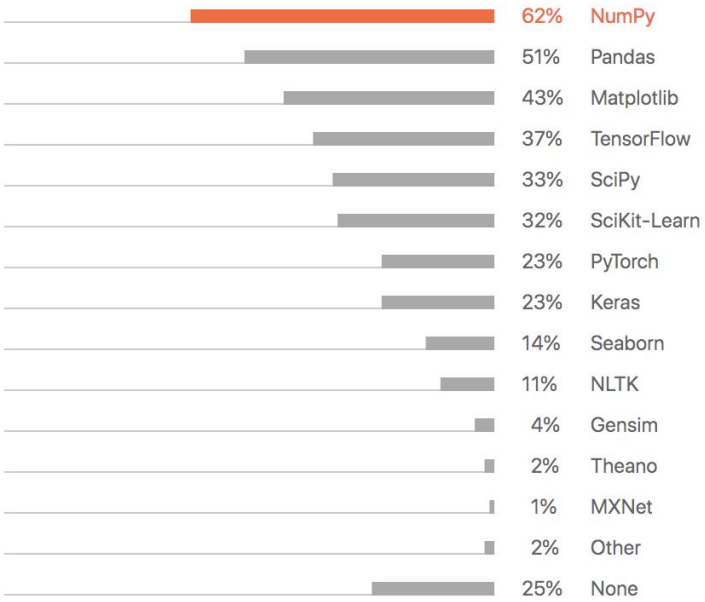
More Flink Users

Learn More: Powered by Flink, Speakers – Flink Forward San Francisco 2019, Speakers – Flink Forward Europe 2019


PYFLINK

Python is at the core of Data Science

What data science frameworks do you use in addition to Python?

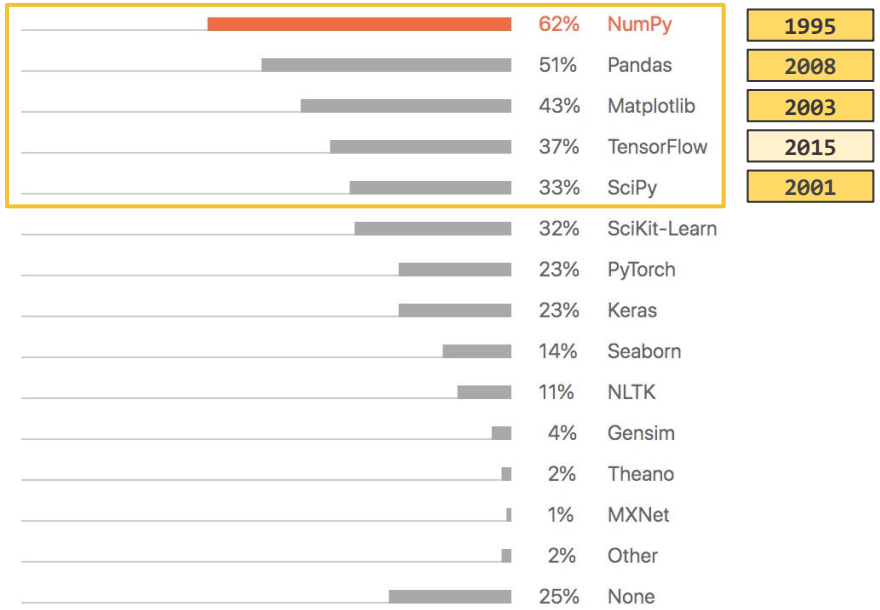


Mature analytics stack, with libraries that are **fast** and **intuitive**.

Source: JetBrains' Developer Ecosystem Report 2020

Python is at the core of Data Science

What data science frameworks do you use in addition to Python?

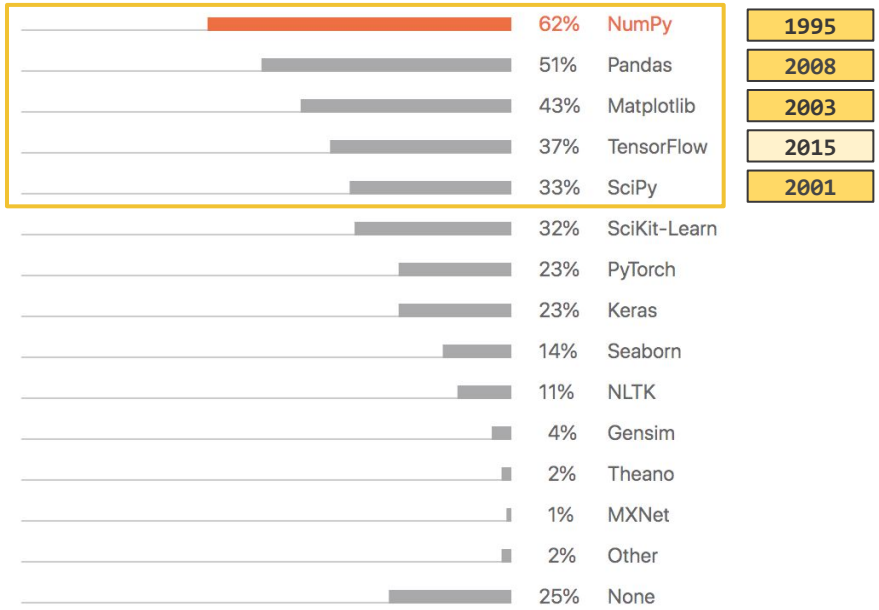


Mature analytics stack, with libraries that are **fast** and **intuitive**.

Source: JetBrains' Developer Ecosystem Report 2020

Python is at the core of Data Science

What data science frameworks do you use in addition to Python?



Mature analytics stack, with libraries that are **fast** and **intuitive**.

Older libraries are mostly **restricted** to a data size that **fits in memory** (RAM), and designed to run on a **single core** (CPU).

This is a problem.

FROM MORE PLACES

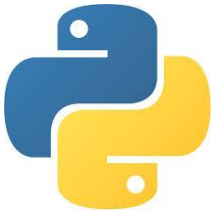
MORE DATA

IN MORE FORMATS

REQUIREMENTS

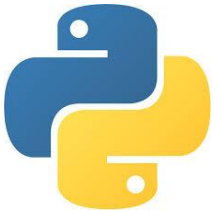
But you still want to use these powerful libraries, right?

Why PyFlink?

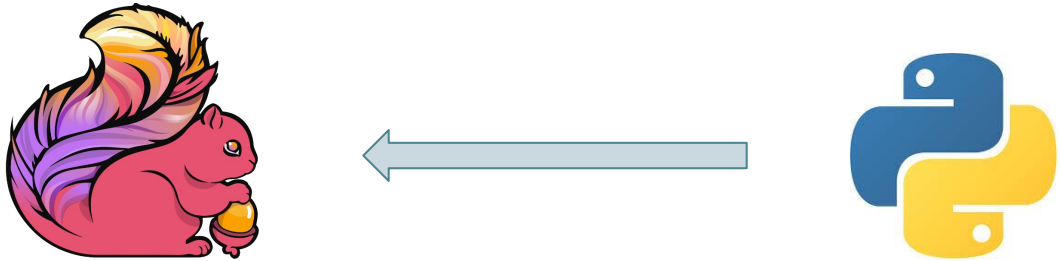


Why PyFlink?

Expose the functionality of Flink to Python users



Why PyFlink?



Distribute and **scale** the functionality of Python through Flink

Learn more: The Integration of Pandas into PyFlink.

Flink can...scale?

Double 11 / Singles Day

Alibaba Group

incl. sub-second updates to the GMV dashboard

Real-time Data Applications

Search | Recomm. | Ads | BI | Security

Infrastructure

>5K nodes

>500K CPU cores

Data Size

985PB

Throughput (Peak)

2.5B events/sec

State Size (Biggest)

100TB

Latency

Sub-sec

Learn more: Optimizations in Blink Runtime for Global Shopping Festival at Alibaba

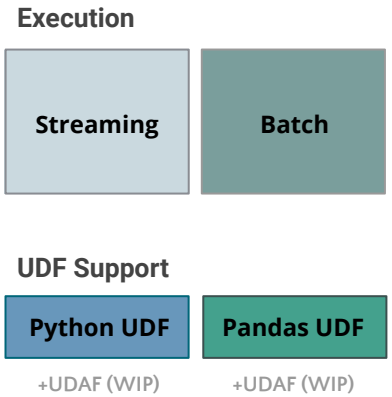
PyFlink in a Nutshell*

- Native SQL integration
- Unified APIs for batch and streaming
- Support for a large set of operations (incl. complex joins, windowing, pattern matching/CEP)

* As of Flink 1.11, only the Table API is exposed through PyFlink. The low-level DataStream API is on the roadmap (FLIP-130).

PyFlink in a Nutshell*

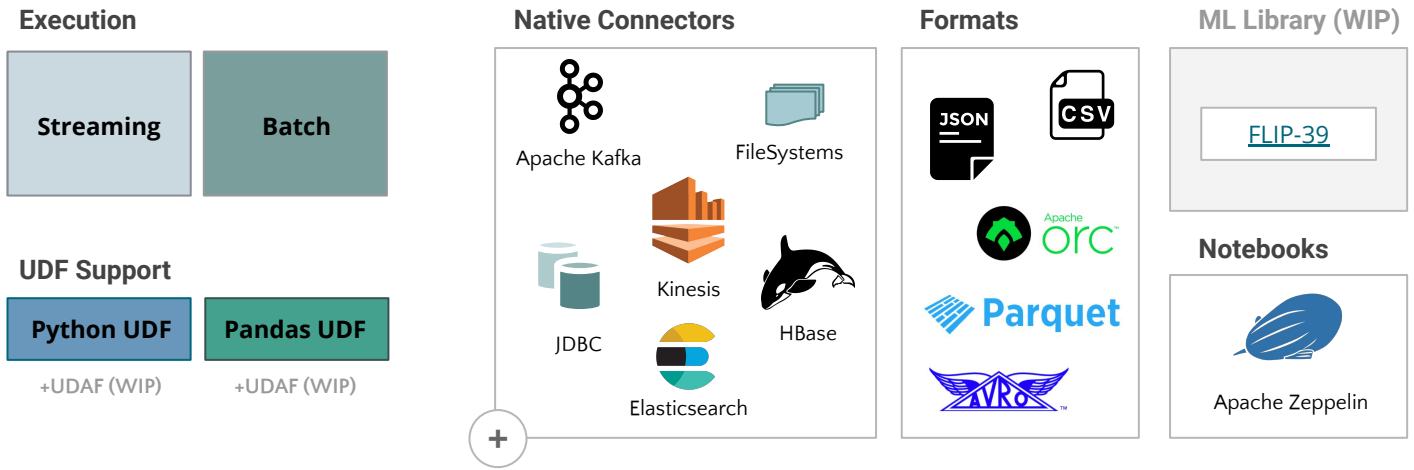
- Native SQL integration
- Unified APIs for batch and streaming
- Support for a large set of operations (incl. complex joins, windowing, pattern matching/CEP)



* As of Flink 1.11, only the Table API is exposed through PyFlink. The low-level DataStream API is on the roadmap (FLIP-130).

PyFlink in a Nutshell*

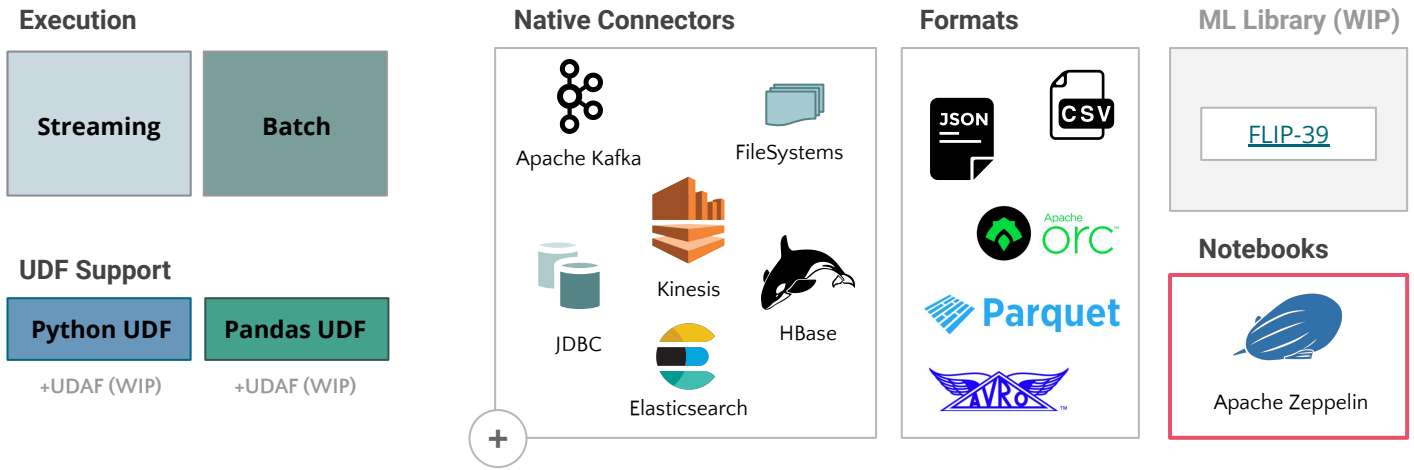
- Native SQL integration
- Unified APIs for batch and streaming
- Support for a large set of operations (incl. complex joins, windowing, pattern matching/CEP)



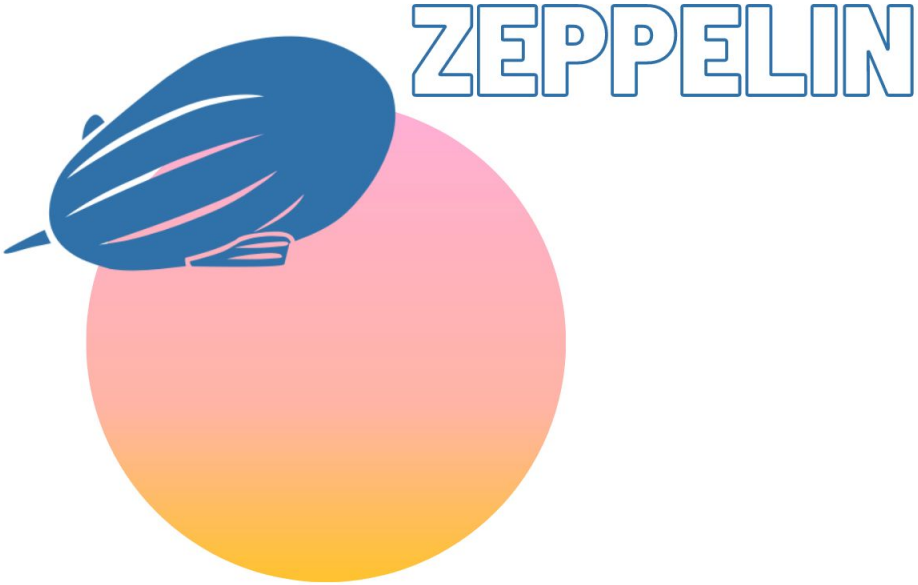
* As of Flink 1.11, only the Table API is exposed through PyFlink. The low-level DataStream API is on the roadmap (FLIP-130).

PyFlink in a Nutshell*

- Native SQL integration
- Unified APIs for batch and streaming
- Support for a large set of operations (incl. complex joins, windowing, pattern matching/CEP)



* As of Flink 1.11, only the Table API is exposed through PyFlink. The low-level DataStream API is on the roadmap (FLIP-130).


ZEPPELIN

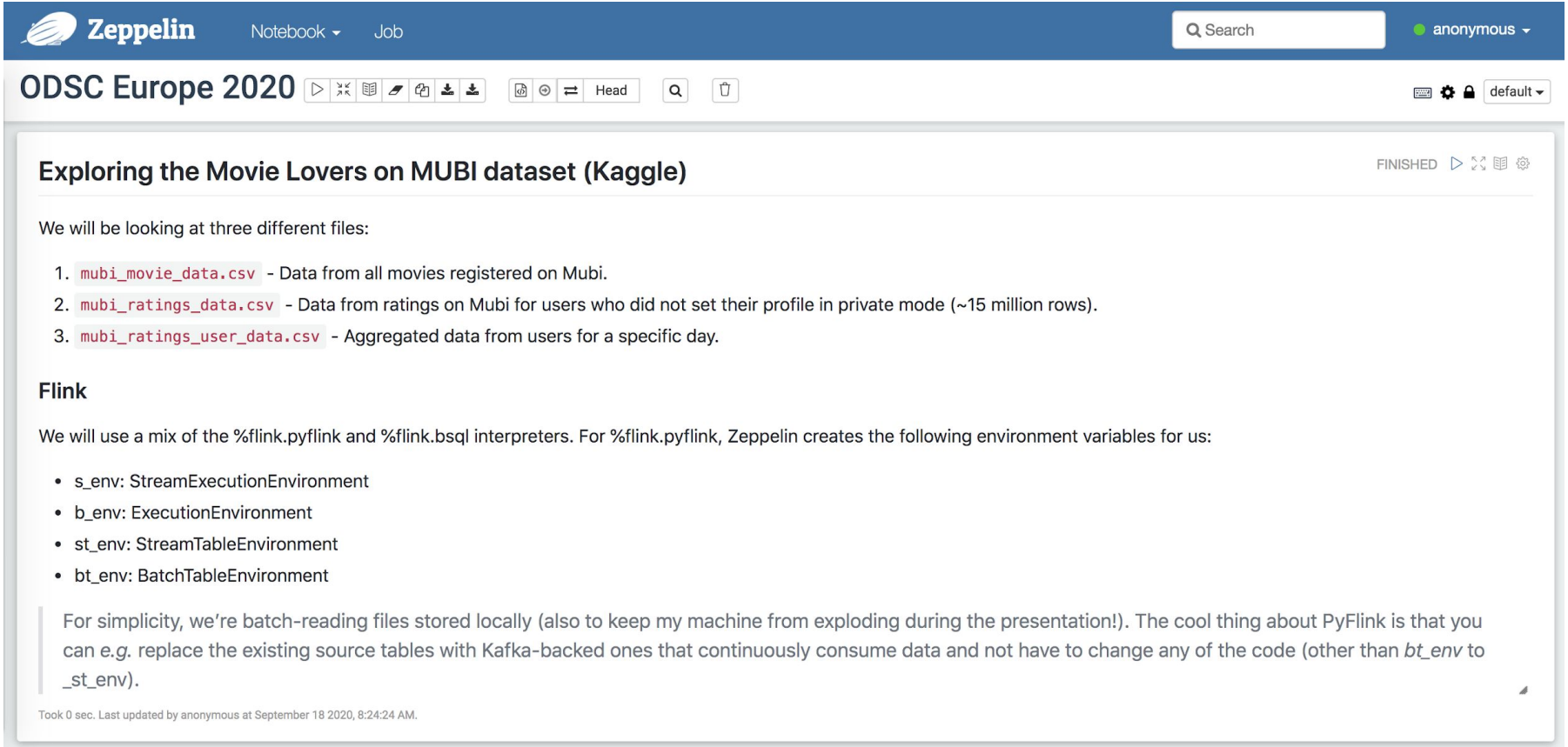
Apache Zeppelin

Web-based notebook that provides an interactive and collaborative computing environment.

Advantages

- Support for *a lot* of interpreters
- Polyglot notes
- Built-in interactive visualizations
- Multi-tenancy
- Pluggable notebook storage (e.g. git)

DEMO


Zeppelin
Notebook
Job
Search
anonymous
ODSC Europe 2020
Head
default
Exploring the Movie Lovers on MUBI dataset (Kaggle)
FINISHED
We will be looking at three different files:
1. mubi_movie_data.csv - Data from all movies registered on Mubi.
2. mubi_ratings_data.csv - Data from ratings on Mubi for users who did not set their profile in private mode (~15 million rows).
3. mubi_ratings_user_data.csv - Aggregated data from users for a specific day.
Flink
We will use a mix of the %flink.pyflink and %flink.bsql interpreters. For %flink.pyflink, Zeppelin creates the following environment variables for us:
• s_env: StreamExecutionEnvironment
• b_env: ExecutionEnvironment
• st_env: StreamTableEnvironment
• bt_env: BatchTableEnvironment
For simplicity, we're batch-reading files stored locally (also to keep my machine from exploding during the presentation!). The cool thing about PyFlink is that you can e.g. replace the existing source tables with Kafka-backed ones that continuously consume data and not have to change any of the code (other than bt_env to _st_env).
Took 0 sec. Last updated by anonymous at September 18 2020, 8:24:24 AM.

DEMO

Option 1. Create table using %flink.pyflink

FLINK JOB FINISHED

```
%flink.pyflink

c_exp_drop_movies = """
DROP TABLE IF EXISTS mubi_movies
"""

c_exp_movies = """
CREATE TABLE mubi_movies (
    movie_id INT,
    movie_title STRING,
    movie_release_year STRING, --Needs cleanup, so bringing in as STRING
    movie_url STRING,
    movie_title_language STRING,
    movie_popularity INT,
    movie_image_url STRING,
    director_id STRING,        --Needs cleanup, so bringing in as STRING
    director_name STRING,
    director_url STRING
)
WITH (
  'connector' = 'filesystem',
  'path' = '/Users/martapaesmoreira/Desktop/ODSC_data/mubi_movie_data.csv',
  'format' = 'csv'
)
"""

bt_env.execute_sql(c_exp_drop_movies)
bt_env.execute_sql(c_exp_movies)

mubi_movies = bt_env \
    .from_path("mubi_movies") \
    .select("movie_id.count as movie_cnt")

z.show(mubi_movies)
```

settings

movie_cnt
226575

Took 6 sec. Last updated by anonymous at September 16 2020, 8:39:51 PM. (outdated)

Option 2. Create table using %flink.bsql

FLINK JOB FINISHED

```
%flink.bsql

DROP TABLE IF EXISTS mubi_movies;

CREATE TABLE mubi_movies (
    movie_id INT,
    movie_title STRING,
    movie_release_year STRING, --Needs cleanup, so bringing in as STRING
    movie_url STRING,
    movie_title_language STRING,
    movie_popularity INT,
    movie_image_url STRING,
    director_id STRING,        --Needs cleanup, so bringing in as STRING
    director_name STRING,
    director_url STRING
)
WITH (
  'connector' = 'filesystem',
  'path' = '/Users/martapaesmoreira/Desktop/ODSC_data/mubi_movie_data.csv',
  'format' = 'csv'
);

--Get a record count.
SELECT COUNT(*) movie_cnt FROM mubi_movies;
```

settings

movie_cnt
226575

Took 5 sec. Last updated by anonymous at September 16 2020, 5:03:21 PM. (outdated)

DEMO

Query the Movie Table

FINISHED

We will use PyFlink to query the `mubi_movies` table and get the average movie popularity per movie release year. What do we see?

1. There are two clear outlier years when it comes to popularity (1878 and 1902). If you check further, there is only one movie release in each of these years on Mubi ("Sallie Gardner at a Gallop" and "A Trip to the Moon") — they're just really popular!
2. The 1920s were a busy period for silent movie releases, which seem pretty popular with Mubi users.
3. The 1920s-1960s are also considered the golden era of Hollywood, so that can also explain the increased popularity of movies released in this period.

> If you visit the Flink Web UI once you click "Run", you will see the job that generated from this code!

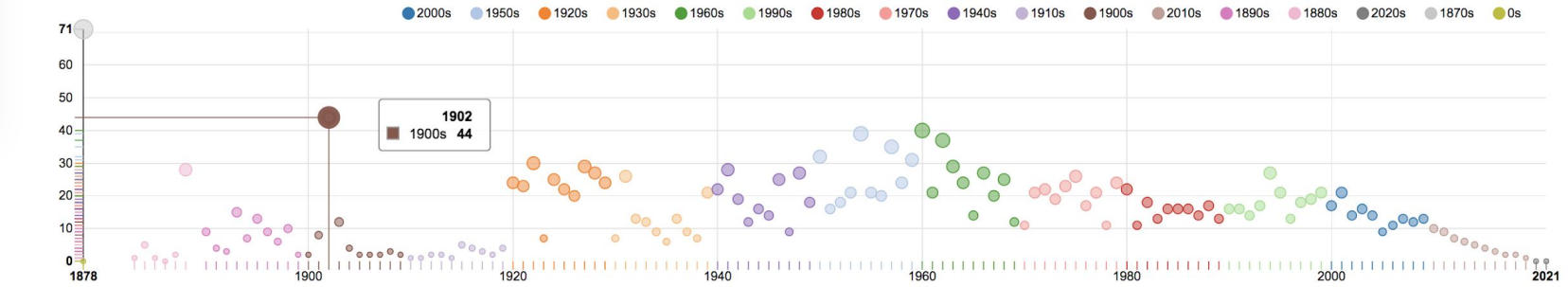
Took 0 sec. Last updated by anonymous at September 18 2020, 8:44:26 AM.

AVG Movie Popularity / Release Year

FLINK JOB FINISHED

```
%flink.pyflink

movies_avg_popularity = bt_env \
    .from_path("mubi_movies") \
    .group_by("movie_release_year") \
    .select("movie_release_year.substring(1,4) AS movie_year,movie_release_year.substring(1,3)+\'0s\' AS movie_decade, movie_popularity.avg AS popularity_avg")

z.show(movies_avg_popularity)
```

settings



DEMO

Active Users over time

FINISHED

Measure: rating activity.

The number of active users in the Mubi platform has seen a steady increase over the years, with a decline followed by steadybut lower activity in comparison, from 2012. It's funny to see that:

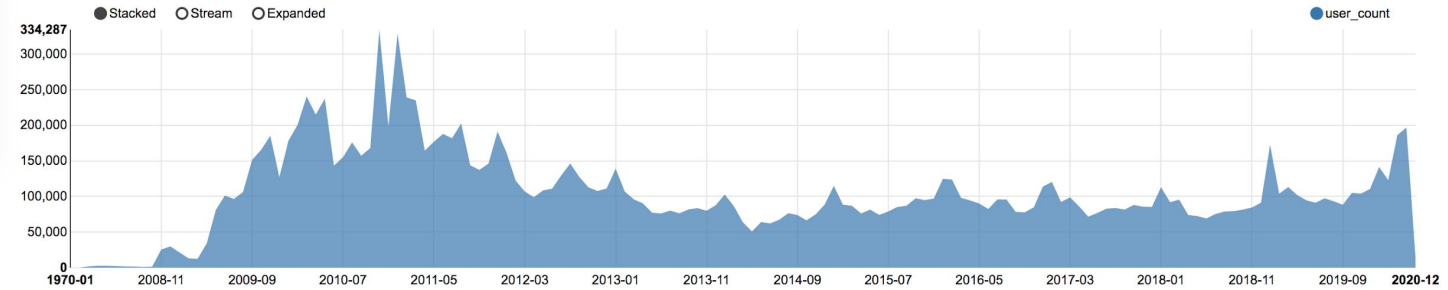
1. There is a peak active users on **January 1st** every year, which is likely when people are making their "BEST OF YEAR X" lists.
2. There was a huge boost in active users when the **Corona pandemic** hit (2020-03).

Took 0 sec. Last updated by anonymous at September 18 2020, 8:45:36 AM.

```
%flink.pyflink

active_users = bt_env \
    .from_path("mubi_ratings") \
    .group_by("rating_timestamp_utc.dateFormat('YYYY-MM') AS rating_ym") \
    .select("rating_ym, user_id.count AS user_count") \
    .order_by("rating_ym")


z.show(active_users)
```

FLINK JOB FINISHED

settings



DEMO

Top 10 Rated Movies in Year X

FLINK JOB FINISHED

```
%flink.pyflink

l_top_10_year = bt_env \
    .from_path("mubi_movies") \
    .select("movie_id, movie_title, movie_release_year")

r_top_10_year = bt_env \
    .from_path("mubi_ratings") \
    .filter("rating_timestamp_utc.dateFormat('YYYY')='"+z.textbox("year", "2020")+"'") \
    .group_by("movie_id") \
    .select("movie_id AS m_id, rating_score.avg AS r_avg, critic.count AS c_critic") \
    .where("r_avg.isNotNull")

top_10_year = l_top_10_year \
    .join(r_top_10_year) \
    .where("movie_id=m_id") \
    .select("movie_title, movie_release_year.substring(1,4) AS movie_year, r_avg AS avg_rating_score, c_critic AS n_user_critics") \
    .order_by("avg_rating_score.desc, n_user_critics.desc") \
    .fetch(10)

z.show(top_10_year)
```

year

2019

settings

movie_title	movie_year	avg_rating_score	n_user_critics
On Cinema at the Cinema	2012	5.0	6
The Day Today	1994	5.0	6
The Peter Serafinowicz Show	2007	5.0	4
Dans l'obscurite	2007	5.0	4
Joe Hisaishi Budokan Studio Ghibli 25 Years	2008	5.0	4

DEMO

Using Pandas (and other Python libraries)

FINISHED

Conversion .toPandas()

One way to use PyFlink with Pandas is to first use it to reduce the amount of data we want to act upon (which might be a considerably small subset of the original dataset), taking advantage of how performant PyFlink is even on the largest of largest datasets; and then convert the resulting table into a Pandas `DataFrame`.

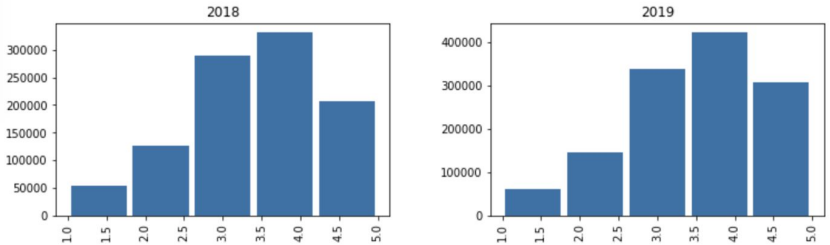
Took 0 sec. Last updated by anonymous at September 18 2020, 9:29:13 AM.

Plotting a Histogram

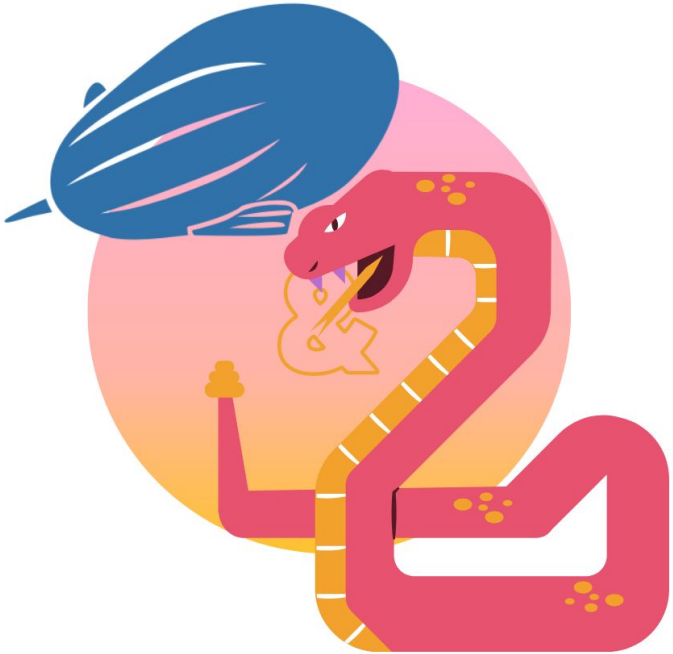
FLINK JOB FINISHED

```
%flink.pyflink

ratings_1820 = bt_env \
    .from_path("mubi_ratings") \
    .filter("rating_timestamp_utc.dateFormat('YYYY').in('2018','2019','2020')") \
    .select("rating_timestamp_utc.dateFormat('YYYY') AS rating_year, rating_score")

pdf = ratings_1820.to_pandas()

ax = pdf.hist(column='rating_score', by='rating_year', bins=5, grid=False, figsize=(12,8), color='#3171A9', zorder=2, rwidth=0.9)

z.show(ax)
```

```
[[<AxesSubplot:title={'center':'2018'}>
  <AxesSubplot:title={'center':'2019'}>]
 [<AxesSubplot:title={'center':'2020'}> <AxesSubplot:>]]
```



Want to learn more about Flink for Data Science?



Thank you, ODSC Europe!

Follow me on Twitter: @morsapaes

Learn more about Flink: https://flink.apache.org/

ververica