Retrieving and Visualizing Real-time data from API

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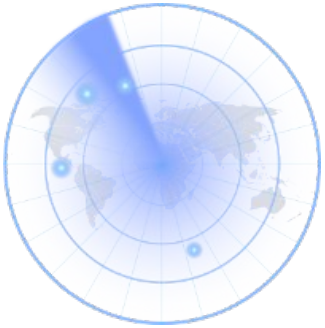
Project Structure

1. The data sets sources and data description
2. Airline Crash Analytics with Python
3. Hadoop and Spark
4. Data preparation and data processing
5. Data Visualization
6. Project reflections



The Open Sky API

REST API `GET /states/all`

Python API

```
class opensky_api.OpenSkyApi()
```

Java API

```
OpenSkyStates os =
api.getMyStates(0, null,
null);
```

Airline Codes

Airline Crashes

source: wikipedia.com

source: socrata.com

\+ Contains very detailed data

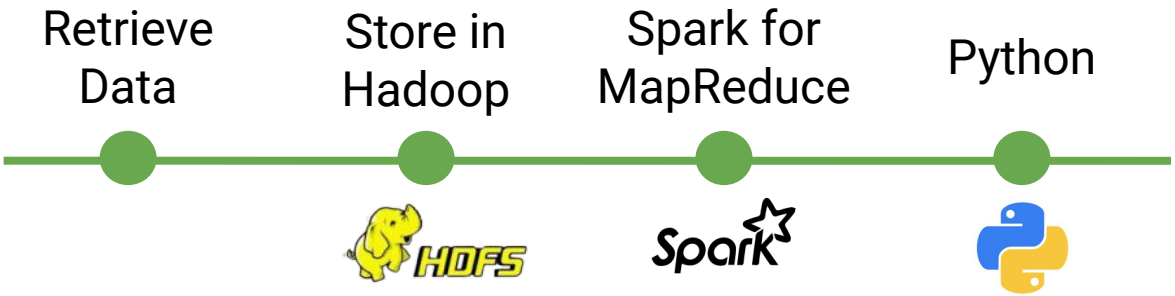
\- Data is old: last entry in 2009

\- A lot of missing values

Technologies

How we proceeded?

Crashes Data



Storing in Hadoop

```
tarazali_ryskul@seneca3:~/airplane$ cd
tarazali_ryskul@seneca3:~$ hadoop fs -put airplane/Airplane_Crashes_Since_1908.csv airplane_hdfs/
tarazali_ryskul@seneca3:~$ hadoop fs -ls airplane_hdfs
found 1 items
-rw-r--r--   3 tarazali_ryskul student    1600720 2019-06-22 15:35 airplane_hdfs/Airplane_Crashes_Si
ce_1908.csv
```

Browse Directory

/user/tarazali_ryskul/airplane_hdfs Go!

Show 25 entries Search:

Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
-rw-r--r--	tarazali_ryskul	student	1.53 MB	Jun 22 15:35	3	128 MB	Airplane_Crashes_Since_1908.csv

Showing 1 to 1 of 1 entries Previous 1 Next

Spark

```
  File "/opt/cloudera/parcels/CDH-6.2.0-1.cdh6.2.0.p0.967373/lib/spark/python/pyspark/sql/utils.py",
 line 69, in deco
    raise AnalysisException(s.split(': ', 1)[1], stackTrace)
pyspark.sql.utils.AnalysisException: u'Path does not exist: hdfs://seneca1.lehre.hwr-berlin.de:8020/
user/tarazali_ryskul/Airplane_Crashes_Since_1908.csv;'
>>> airplane = spark.read.csv("airplane_hdfs/Airplane_Crashes_Since_1908.csv", header=True, inferSch
ema=True)
>>> airplane.count()
5268
>>> airplane.schema()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
TypeError: 'StructType' object is not callable
>>> airplane.printSchema()
root
 |-- Date: string (nullable = true)
 |-- Time: string (nullable = true)
 |-- Location: string (nullable = true)
 |-- Operator: string (nullable = true)
 |-- Flight #: string (nullable = true)
 |-- Route: string (nullable = true)
 |-- Type: string (nullable = true)
 |-- Registration: string (nullable = true)
 |-- cn/In: string (nullable = true)
 |-- Aboard: integer (nullable = true)
 |-- Fatalities: integer (nullable = true)
 |-- Ground: integer (nullable = true)
 |-- Summary: string (nullable = true)

>>>
```

Location-Operator

Location	Operator	avg(Fatalities)
Chicago, Illinois	Chicago-Detroit A...	1.0
Sir Lowry's pass,...	Union Airways	3.0
Haydens Peak, Wyo...	United Air Lines	19.0
Bucharest, Romania	LARES	15.0
English Channel, ...	British Overseas ...	9.0
Castel Benito, Libya	Skyways of London	1.0
Gao, French West ...	Société Aérienne ...	17.0
Near San Felipe, ...	TACA	12.0
Christchurch, New...	Straits Air Freig...	4.0
Near Manila, Phil...	Philippine Air Lines	1.0
East Nassau, New ...	Chester Airport	3.0
Near Shanghai, China	CAAC	40.0
Guangzhou, China	Total	8.0
Java Sea, Indonesia	Pelita Air Service	9.0
Near Tamworth, A...	Jetcraft	1.0
Sao Gabriel, Brazil	Rico Taxi Aero	8.0
Matsu Island, Taiwan	Formosa Airlines	16.0
AtlantiOcean, off...	Renan Airways	5.0
Bluefields, Nicar...	Fuerza Aérea Nica...	28.0
Near Puerto Cabel...	Private - OverteC...	13.0

only showing top 20 rows

Location Splitting

```
+--------------------+
|            Location|
+--------------------+
|Schievelbein, Ger...|
|Near Walsenberg, ...|
| Schiphol, Amsterdam|
|   Sweetwater, Texas|
|Mt. Banahaur, Phi...|
|Braemar Resevoir,...|
|  Caracas, Venezuela|
|Willamsport, Penn...|
|Near San Francisc...|
|Off Tangiers, Mor...|
|Near Hasloh, Germany|
|Sierra de Atalaya...|
|Straits of Johore...|
|   Nightmute, Alaska|
|Near Cuenca, Azua...|
|Wilmington, North...|
|950 nm S of  Shem...|
|      Arequipa, Peru|
|Yangon (Rangoon),...|
|Off Mannar, Sri L...|
+--------------------+
only showing top 20 rows
```

```
AttributeError: 'module' object has no attribute 'functions'
>>> import pyspark.sql.functions
>>> split_col = pyspark.sql.functions.split(airplane['Location'], ',')
>>> airplane = airplane.withColumn('Country', split_col.getItem(1))
>>> airplane.show()
+---------+-----+--------------------+--------------------+-------+------------+----------------
---+------------+-----+------+---------+------+--------------------+----------------+
|      Date| Time|            Location|            Operator|Flight #|       Route|                T
ype|Registration|cn/In|Aboard|Fatalities|Ground|             Summary|         Country|
+---------+-----+--------------------+--------------------+-------+------------+----------------
---+------------+-----+------+---------+------+--------------------+----------------+
|09/17/1908|17:18| Fort Myer, Virginia|Military - U.S. Army|    null|Demonstration|    Wright Flyer
III|        null|    1|     2|        1|     0|During a demonstr...|        Virginia|
|07/12/1912|06:30|AtlantiCity, New ...|Military - U.S. Navy|    null|  Test flight|           Dirigi
ble|        null| null|     5|        5|     0|First U.S. dirigi...|      New Jersey|
|08/06/1913| null|Victoria, British...|             Private|      -|         null|    Curtiss seapl
ane|        null| null|     1|        1|     0|The first fatal a...| British Columbia|
|09/09/1913|18:30|  Over the North Sea|Military - German...|    null|         null|Zeppelin L-1 (air
...|        null| null|    20|       14|     0|The airship flew ...|            null|
|10/17/1913|10:30|Near Johannisthal...|Military - German...|    null|         null|Zeppelin L-2 (air
...|        null| null|    30|       30|     0|Hydrogen gas whic...|         Germany|
|03/05/1915|01:00|     Tienen, Belgium|Military - German...|    null|         null|Zeppelin L-8 (air
```

Country RDD

```
>>> country = airplane.select('Country').collect()
>>> country.show()
Traceback (most recent call last):
  File "<stdin>", line 1, in <module>
AttributeError: 'list' object has no attribute 'show'
>>> country
[Row(Country=u' Virginia'), Row(Country=u' New Jersey'), Row(Cou
try=None), Row(Country=u' Germany'), Row(Country=u' Belgium'), R
=u' Bulgeria'), Row(Country=u' England'), Row(Country=u' Englan
untry=u' England'), Row(Country=u' Belgium'), Row(Country=None),
ntry=u' North Sea'), Row(Country=None), Row(Country=u' France'),
ermany'), Row(Country=u' North Sea'), Row(Country=u' New Jersey
```

```
>>> df_count = spark.createDataFrame(country).show()
+-----------------+
|          Country|
+-----------------+
|         Virginia|
|       New Jersey|
| British Columbia|
|             null|
|          Germany|
|          Belgium|
|          Germany|
|         Bulgeria|
|          England|
|          England|
|          Germany|
|          England|
|          Belgium|
|             null|
|        North Sea|
|        North Sea|
|             null|
|           France|
|             null|
|          Germany|
+-----------------+
only showing top 20 rows
```

Country MapReduce

```
>>> text_file = sc.textFile("airplane_hdfs/country.txt")
>>> text_file.collect()
[u'Virginia', u'New Jersey', u'British Columbia', u'"', u'Germa
lgium', u'"', u'North Sea', u'North Sea', u'"', u'France', u'
, u'"', u'New Jersey', u'Indiana', u'New Jersey', u'New Jersey
ania', u'France', u'Spain', u'Illinois', u'Wyoming', u'England'
ng', u'California', u'France', u'England', u'France', u'Austral
Italy', u'Morocco', u'Morocco', u'France', u'Spain', u'Wyoming'
Pennsylvania', u'"', u'Colombia', u'"', u'France', u'Indiana',
```

```
>>> wor = text_file.flatMap(lambda line:line.split("\n"))
>>> wor.collect()
[u'Virginia', u'New Jersey', u'British Columbia', u'"', u'Germany',
lgium', u'"', u'North Sea', u'North Sea', u'"', u'France', u'"', u
, u'"', u'New Jersey', u'Indiana', u'New Jersey', u'New Jersey', u'
ania', u'France', u'Spain', u'Illinois', u'Wyoming', u'England', u'Sp
ng', u'California', u'France', u'England', u'France', u'Australia', u
Italy', u'Morocco', u'Morocco', u'France', u'Spain', u'Wyoming', u'Pe
Pennsylvania', u'"', u'Colombia', u'"', u'France', u'Indiana', u'En
', u'France', u'Ohio', u'France', u'Ohio', u'Germany', u'"', u'Czech
u'Oregon', u'France', u'Morocco', u'Qld', u'Idaho', u'Indiana', u'Ger
ermany', u'Mauritania', u'New Jersey', u'France', u'"', u'Indiana',
', u'Brazil', u'France', u'Wyoming', u'Spain', u'"', u'Minnesota', u
```

```
>>> word_tup = wor.map(lambda word: (word,1))
>>> word_tup.collect()
[(u'Virginia', 1), (u'New Jersey', 1), (u'British
 1), (u'England', 1), (u'Germany', 1), (u'England'
 1), (u'Germany', 1), (u'North Sea', 1), (u'New Je
, 1), (u'Indiana', 1), (u'New Jersey', 1), (u'New
y', 1), (u'Ohio', 1), (u'Pennsylvania', 1), (u'Fra
), (u'Wisconsin', 1), (u'"', 1), (u'Nevada', 1),
', 1), (u'France', 1), (u'Australia', 1), (u'Franc
```

```
>>> counts_word = word_counts.map(lambda (x,y): (y,x))
>>> counts_word.collect()
[(47, u'Canada'), (1, u'East Timor'), (12, u'Mississippi'),
, u'Lithuania'), (4, u'Cambodia'), (19, u'Switzerland'), (1,
, (19, u'Louisiana'), (1, u'Republiof Djibouti'), (51, u'Texa
 (8, u'Azores'), (1, u'Channel Islands'), (1, u'Da Nang'), (1
 u'Germany'), (1, u'UAE'), (14, u'Panama'), (1, u'Dominica')
, u'Tanzania'), (1, u'Rhodesia (Zimbabwe)'), (1, u'Zulia'),
```

Country MapReduce

```
>>> word_counts = word_tup.reduceByKey(lambda x,y:x+y)
>>> word_counts.collect()
[(u'Canada', 47), (u'near Point Barrow', 1), (u'Mississippi', 12), (u'Antigua', 1), (u'WA', 2), (u'Virginia.', 1), (u'East Germany', 4), (u'Hrvatska', 1), (u'
Lithuania', 1), (u'Cambodia', 4), (u'110 miles West of Ireland', 1), (u'Covington', 1), (u'Bosnia Herzegovina', 1), (u'Kent', 2), (u'Argentina', 44), (u'Louis
iana', 19), (u'India / Kandahar', 1), (u'Texas', 51), (u'Ghana', 2), (u'Romainia', 1), (u'Saudi Arabia', 15), (u'near Sibiu', 1), (u'Bugaria', 1), (u'Azores',
 8), (u'N of  Santander', 1), (u'Channel Islands', 1), (u'Orly', 1), (u'Cailifornia', 1), (u'U.S. Virgin Islands', 2), (u'Guatemala', 17), (u'Wisconson', 3),
(u'Germany', 78), (u'Timor', 2), (u'Panama', 14), (u'Spain', 60), (u'Western Samoa', 1), (u'Island of Madeira', 1), (u'Miami', 1), (u'Tanzania', 6), (u'Rhodes
ia (Zimbabwe)', 1), (u'Gabon', 5), (u'Luxembourg', 2), (u'West Vlaanderen', 1), (u'Thiells', 1), (u'Samoa', 1), (u'New Zealand', 24), (u'Dominican Republic',
5), (u'Jersey', 2), (u'England', 85), (u'Brisbane', 1), (u'Belgium Congo', 1), (u'Guam', 4), (u'India', 95), (u'off Ustica', 1), (u'Hati', 1), (u'New Jersey',
 40), (u'Africa', 1), (u'London', 3), (u'Arkansas', 13), (u'South Korea', 17), (u'Tajikistan', 1), (u'Great Inagua', 1), (u'Turkey', 31), (u'British Virgin Is
lands', 1), (u'Caribbean', 1), (u'Ireland', 14), (u'Lombardia', 1), (u'Solomon Islands', 2), (u'Washington', 43), (u'Saint Lucia', 1), (u'West Germany', 8), (
u'Kyrgyzstan', 2), (u'Mongolia', 6), (u'18 NNW of Benton Harbor', 1), (u'Inner Mongolia', 1), (u'Louisana', 1), (u'Slovakia', 2), (u'Peru', 52), (u'Maryland',
 21), (u'Norway', 29), (u'Domincan Republic', 1), (u'Cook Islands', 1), (u'NWT', 1), (u'Uzbekistan', 9), (u'Jiangsu', 1), (u'Wisconsin', 9), (u'Sumarta', 1),
(u'Lombok Island', 1), (u'Huanuco', 1), (u'Cameroon', 12), (u'Michigan', 27), (u'Oregon', 16), (u'near Ft. Collins', 1), (u'Coloado', 1), (u'China', 78), (u'W
```

```
>>> sorted.take(50)
[(208, u'"'), (178, u'Brazil'), (173, u'Alaska'), (169, u'Russia'), (145, u'Colombia'), (138, u'California'), (122, u'France'), (95, u'India'), (85, u'Englan
d'), (82, u'Indonesia'), (80, u'Mexico'), (78, u'Germany'), (78, u'China'), (73, u'Italy'), (68, u'Philippines'), (60, u'Spain'), (59, u'New York'), (56, u'Ve
nezuela'), (52, u'Australia'), (52, u'Peru'), (51, u'Texas'), (50, u'Ohio'), (47, u'Canada'), (46, u'Bolivia'), (44, u'Argentina'), (43, u'Washington'), (42,
u'Pennsylvania'), (41, u'Japan'), (41, u'Florida'), (41, u'Angola'), (40, u'New Jersey'), (39, u'Illinois'), (39, u'Colorado'), (38, u'Egypt'), (37, u'South V
ietnam'), (36, u'Georgia'), (35, u'Iran'), (35, u'Taiwan'), (34, u'Vietnam'), (33, u'Ecuador'), (32, u'Hawaii'), (31, u'Arizona'), (31, u'USSR'), (31, u'Turke
y'), (31, u'Nigeria'), (30, u'Sudan'), (29, u'Pakistan'), (29, u'Afghanistan'), (29, u'Norway'), (28, u'Nevada')]
>>>
```

Distributed Storage

Browse Directory

/user/tarazali_ryskul/Country Go!

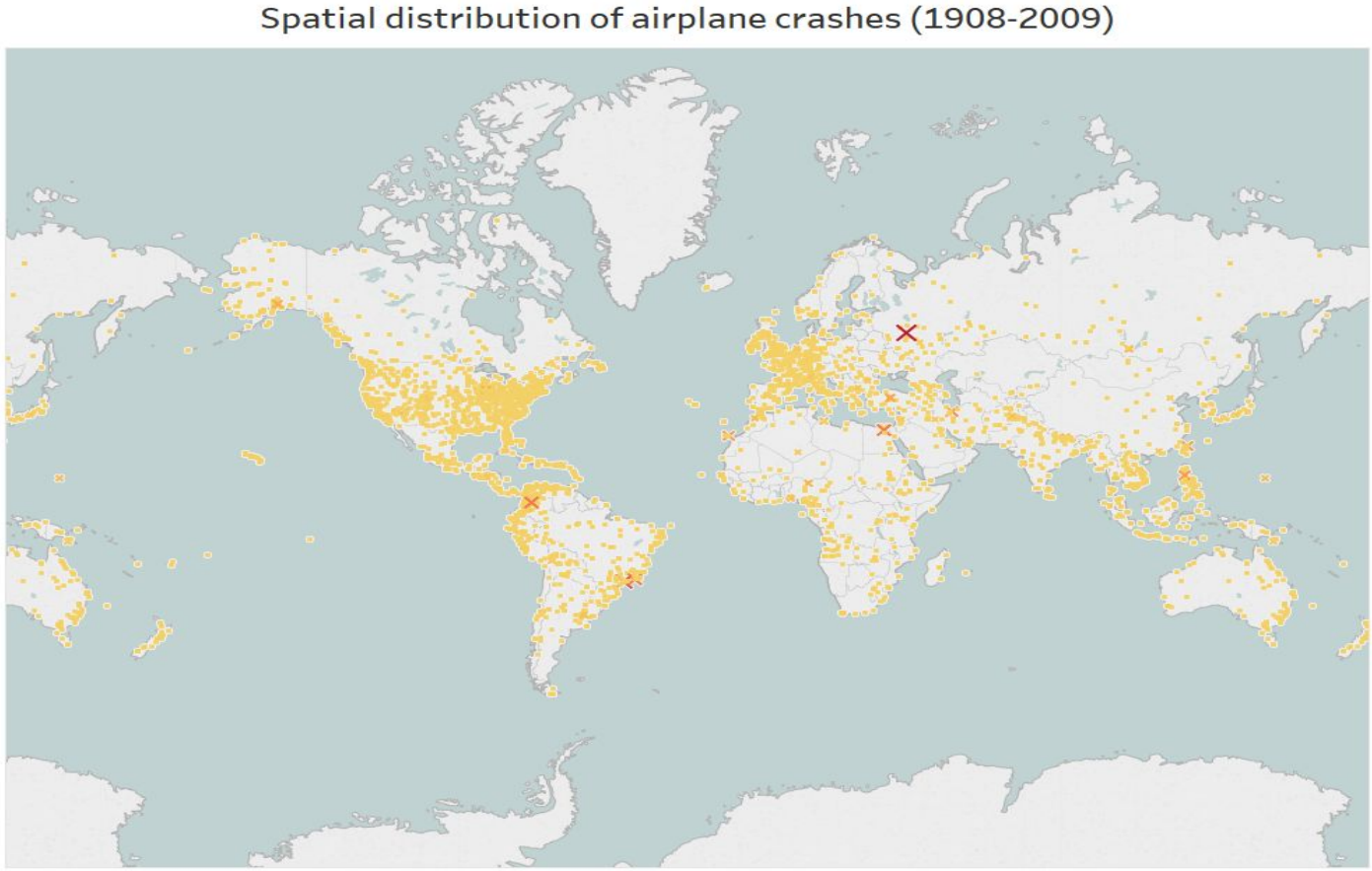
Show 25 entries Search:

Permission	Owner	Group	Size	Last Modified	Replication	Block Size	Name
-rw-r--r--	tarazali_ryskul	student	0 B	Jun 22 20:37	3	128 MB	_SUCCESS
-rw-r--r--	tarazali_ryskul	student	43.79 KB	Jun 22 21:05	3	128 MB	country.txt
-rw-r--r--	tarazali_ryskul	student	25.12 KB	Jun 22 20:37	3	128 MB	part-00000-1506decb-421e-42f2-8de6-9fc8f4cba87e-c000.csv
-rw-r--r--	tarazali_ryskul	student	18.67 KB	Jun 22 20:37	3	128 MB	part-00001-1506decb-421e-42f2-8de6-9fc8f4cba87e-c000.csv

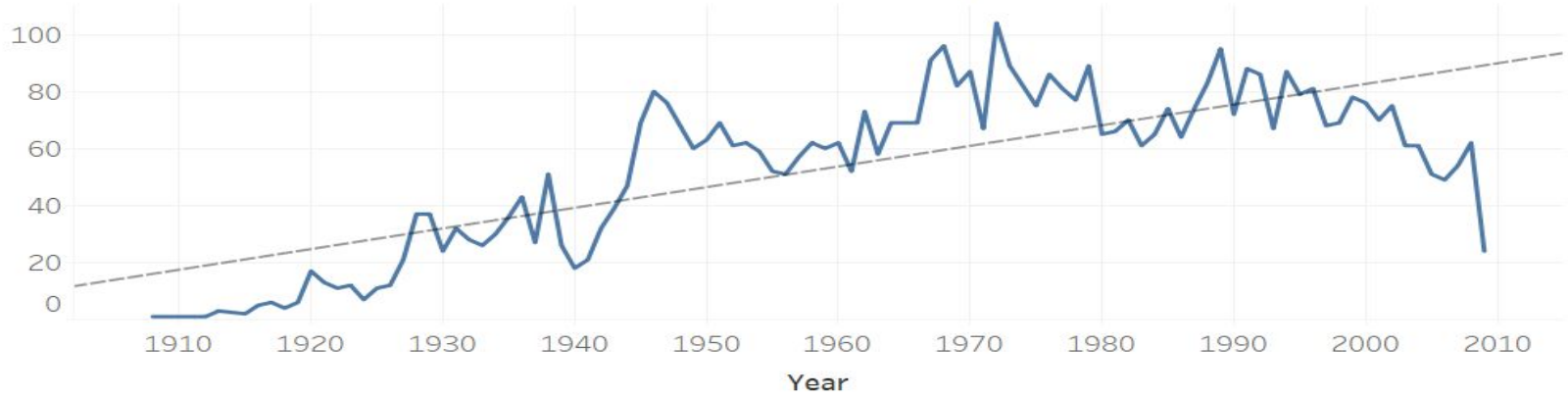
Showing 1 to 4 of 4 entries

Previous 1 Next

Data Visualization

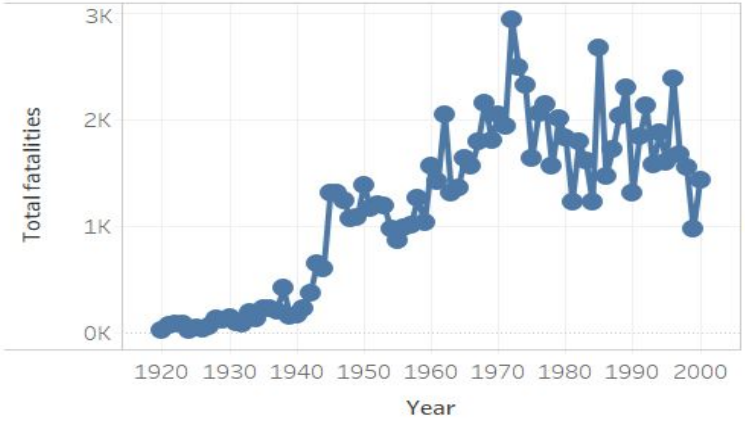


Total number of crashes per Year

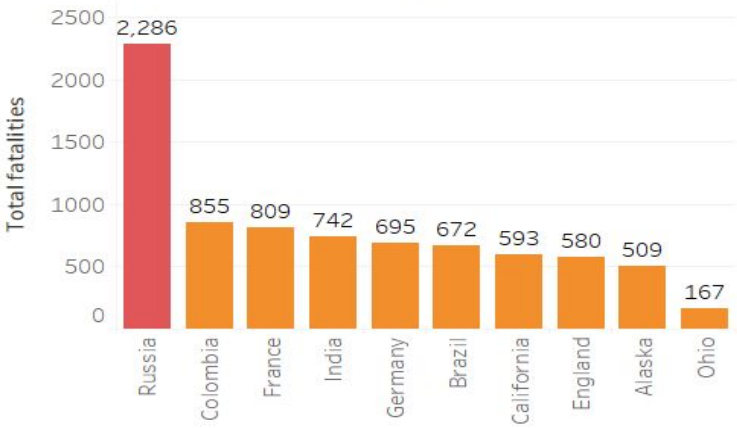


Total number of crashes per Month

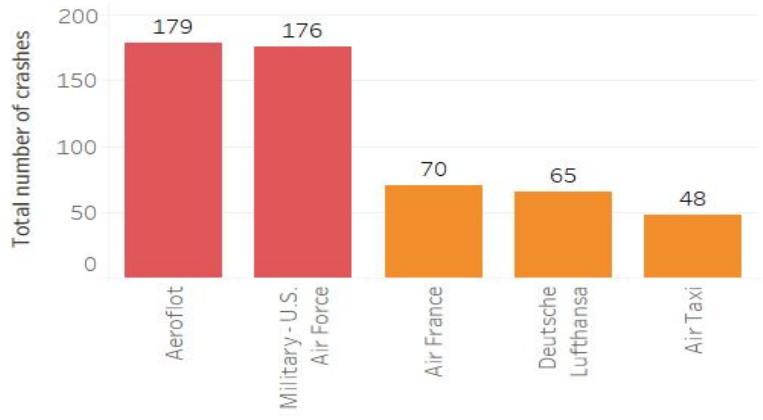
Fatalities per year



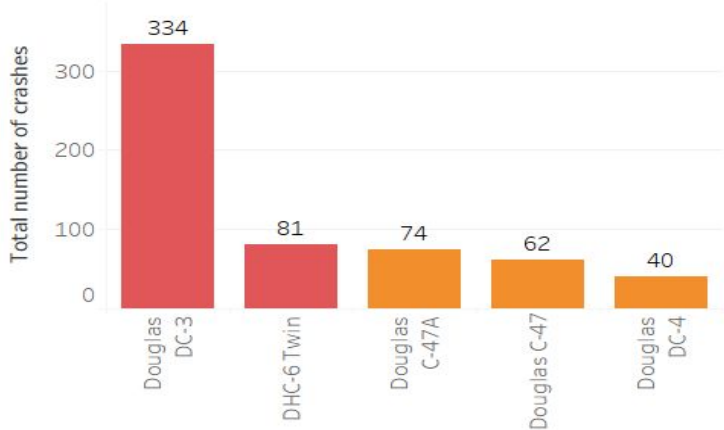
Top countries with highest fatalities

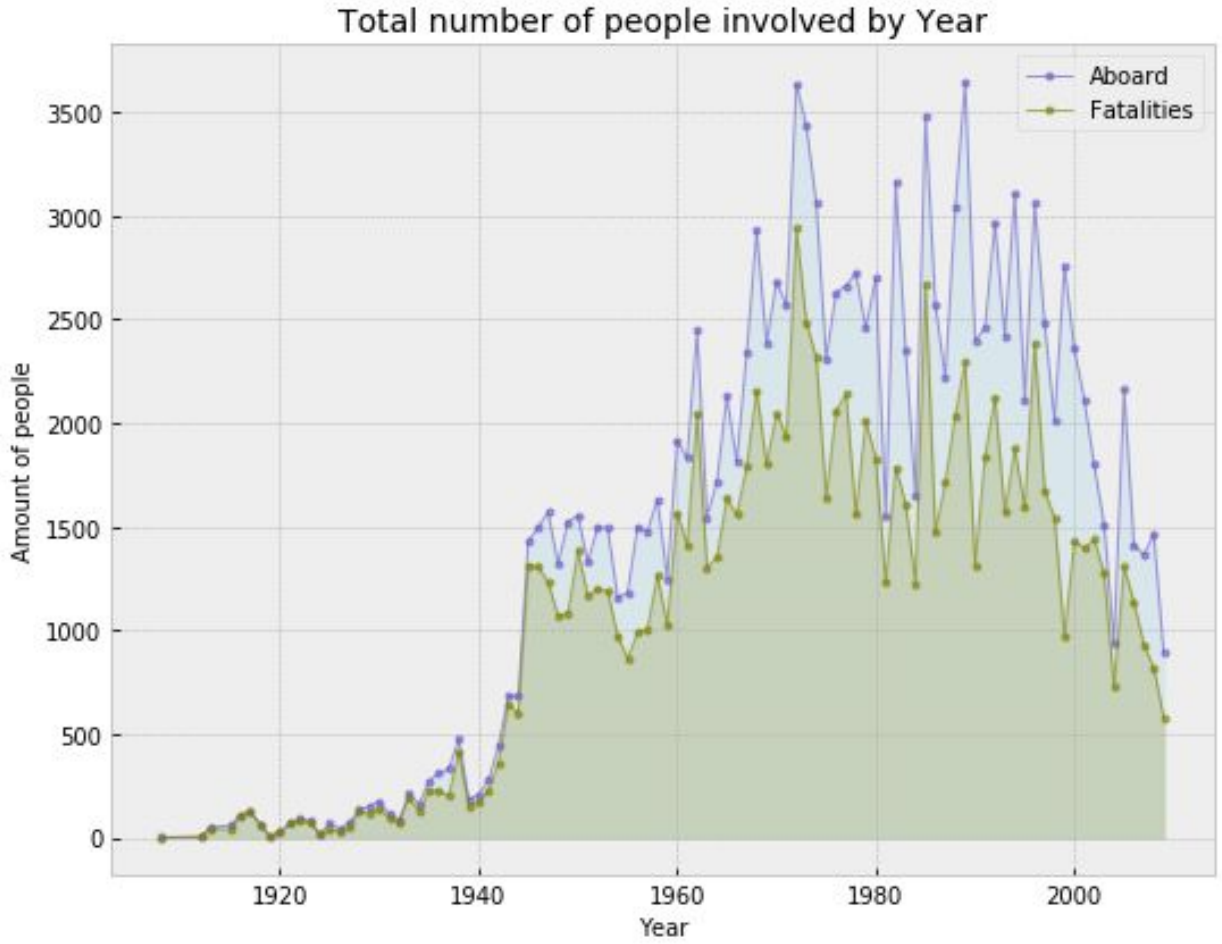


Top 5 airlines involved



Aircraft type - top 5




Total number of people involved by Year
Aboard
Fatalities
Amount of people
3500
3000
2500
2000
1500
1000
500
0
1920
1940
1960
1980
2000
Year

Topic Modelling

Preprocessing

```
[['demonstration', 'flight', 'army', 'flyer', 'fly'
'kill', 'lt', 'thomas', 'selfridge', 'passenger', '
ight', 'tear', 'loose', 'wire', 'brace', 'rudder',
'ribs', 'pelvi', 'leg', 'selfridge', 'suffer', 'cru
```

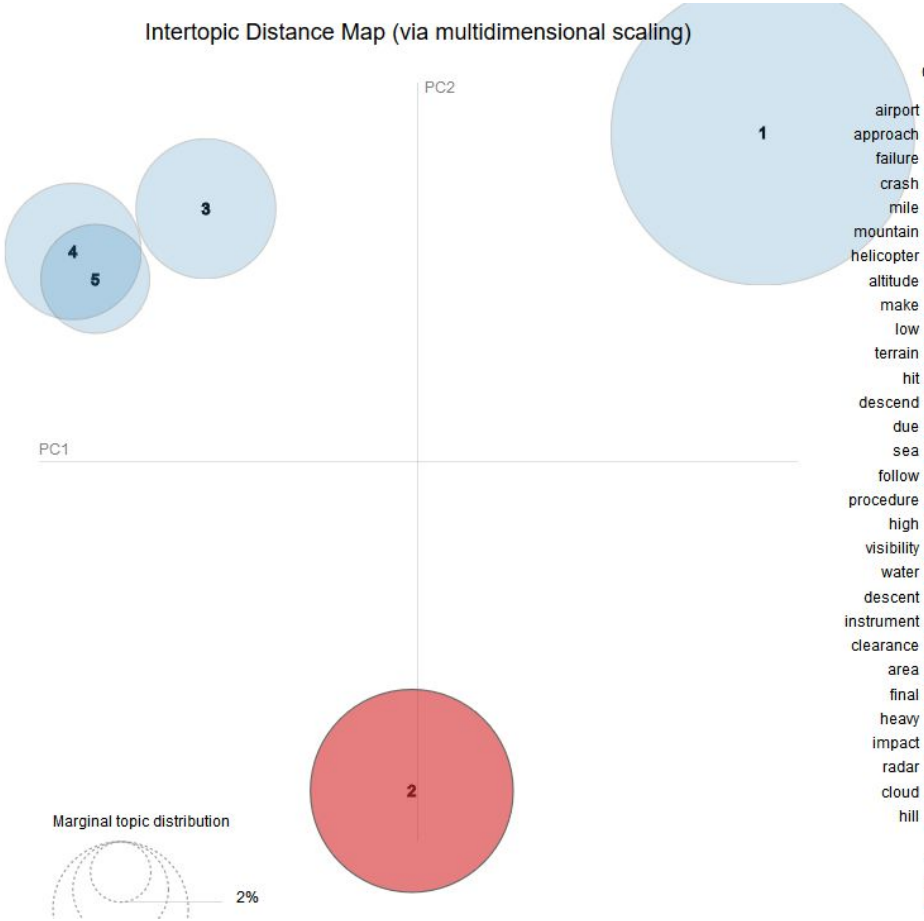
Corpus Dictionary

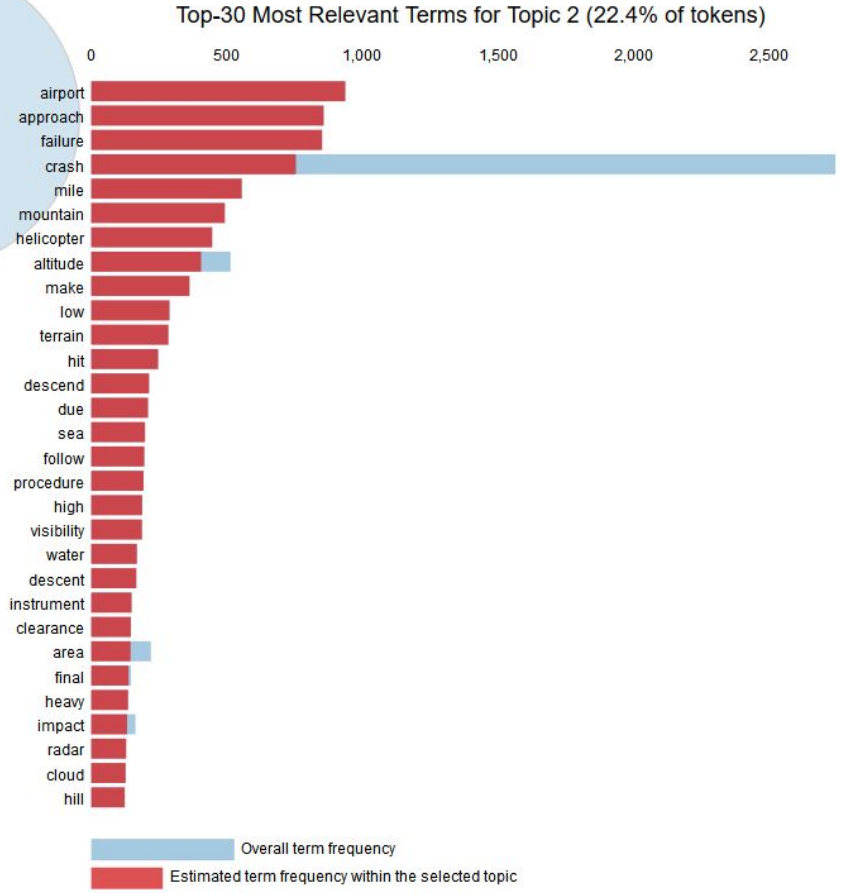
```
[[(0, 1), (1, 1), (2, 1), (3, 1), (4, 1),
1), (16, 1), (17, 1), (18, 1), (19, 1), (2
(30, 1), (31, 1), (32, 1), (33, 1), (34, 2
```

Pilot faults and engine issues

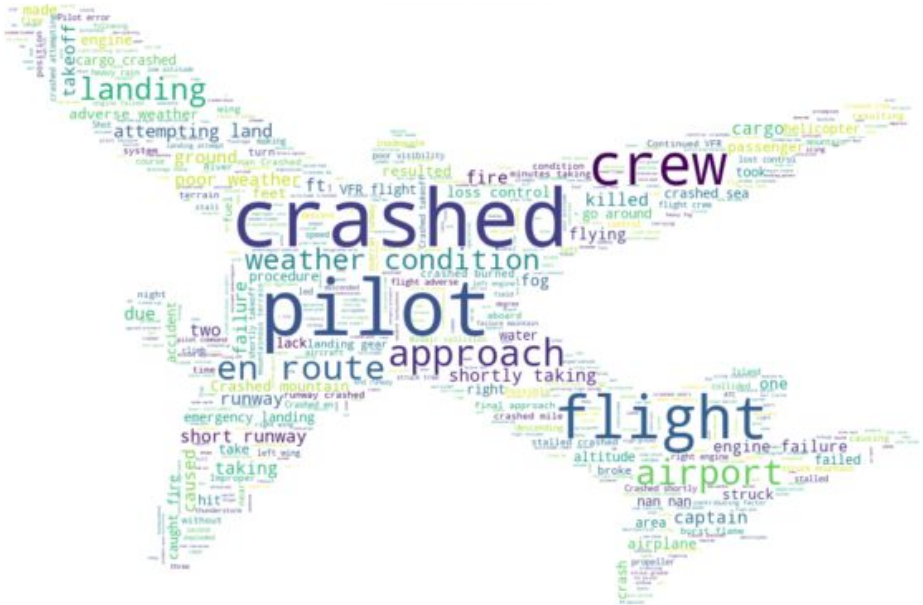
Weather conditions

```
[(0,
 '0.059*"plane" + 0.047*"crash" + 0.039*"pilot" + 0.025*"runway" + '
 '0.023*"take" + 0.021*"engine" + 0.020*"crew" + 0.019*"land" + '
 '0.016*"attempt" + 0.014*"flight"'),
(1,
 '0.067*"flight" + 0.056*"condition" + 0.055*"weather" + 0.043*"takeoff" + '
 '0.036*"poor" + 0.031*"fog" + 0.019*"ice" + 0.015*"side" + 0.013*"burst" + '
 '0.012*"destroy"'),
```


Intertopic Distance Map (via multidimensional scaling)
PC2
PC1
1
2
3
4
5
Marginal topic distribution
2%


Top-30 Most Relevant Terms for Topic 2 (22.4% of tokens)
0
500
1,000
1,500
2,000
2,500
airport
approach
failure
crash
mile
mountain
helicopter
altitude
make
low
terrain
hit
descend
due
sea
follow
procedure
high
visibility
water
descent
instrument
clearance
area
final
heavy
impact
radar
cloud
hill
Overall term frequency
Estimated term frequency within the selected topic

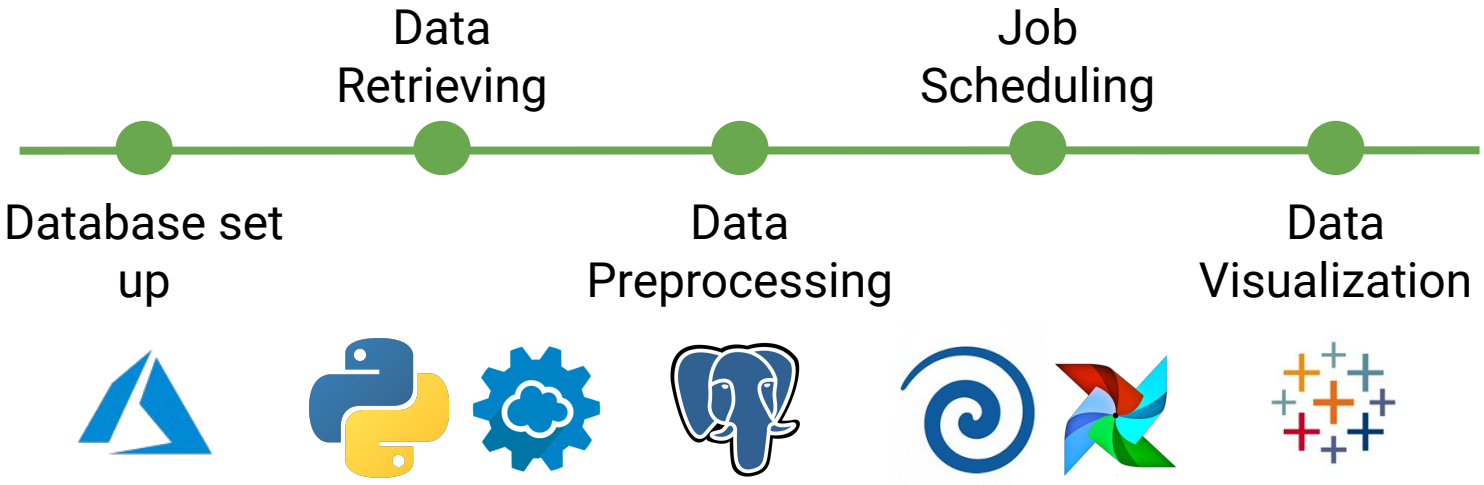
Brief Summary



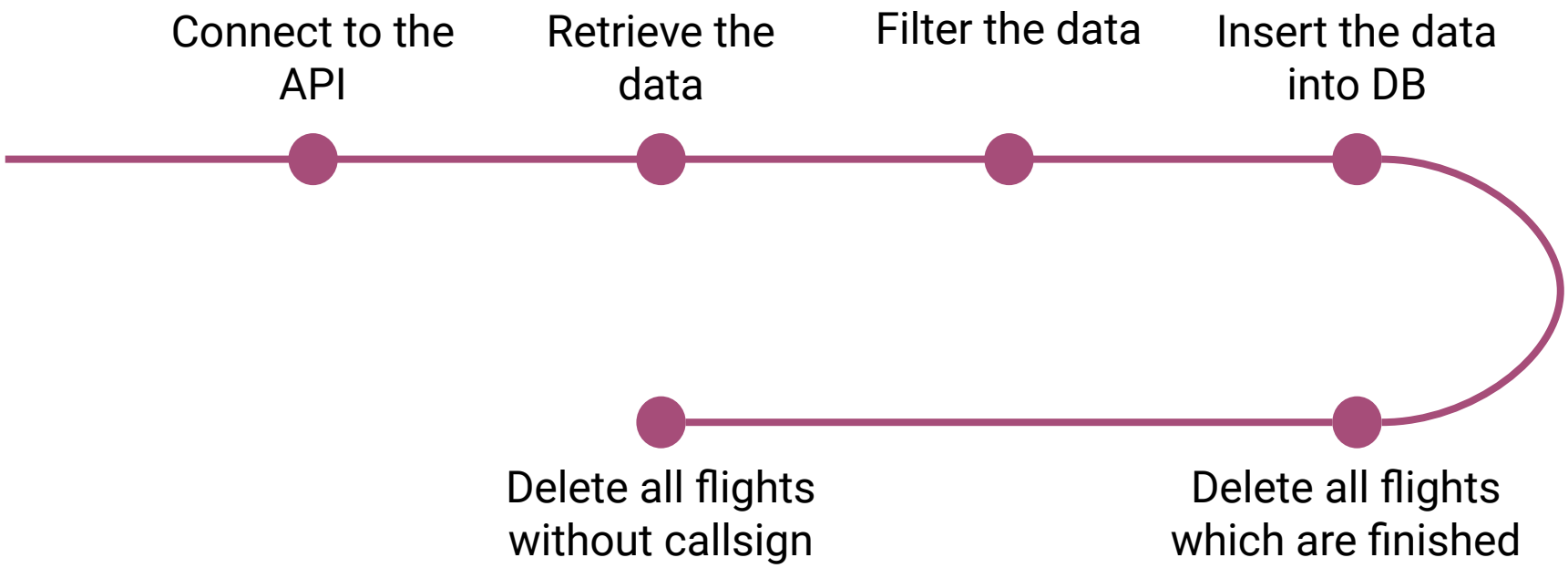
Location of Accident

How we proceeded?

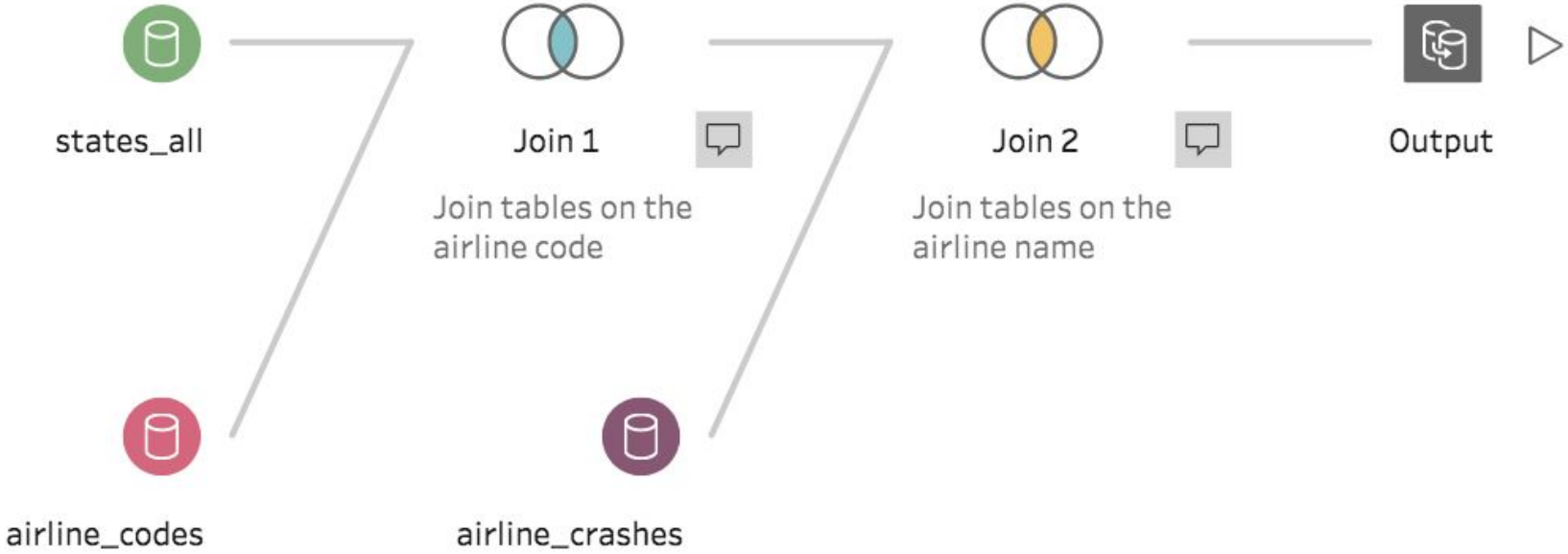
Flights Data



Job scheduler flow

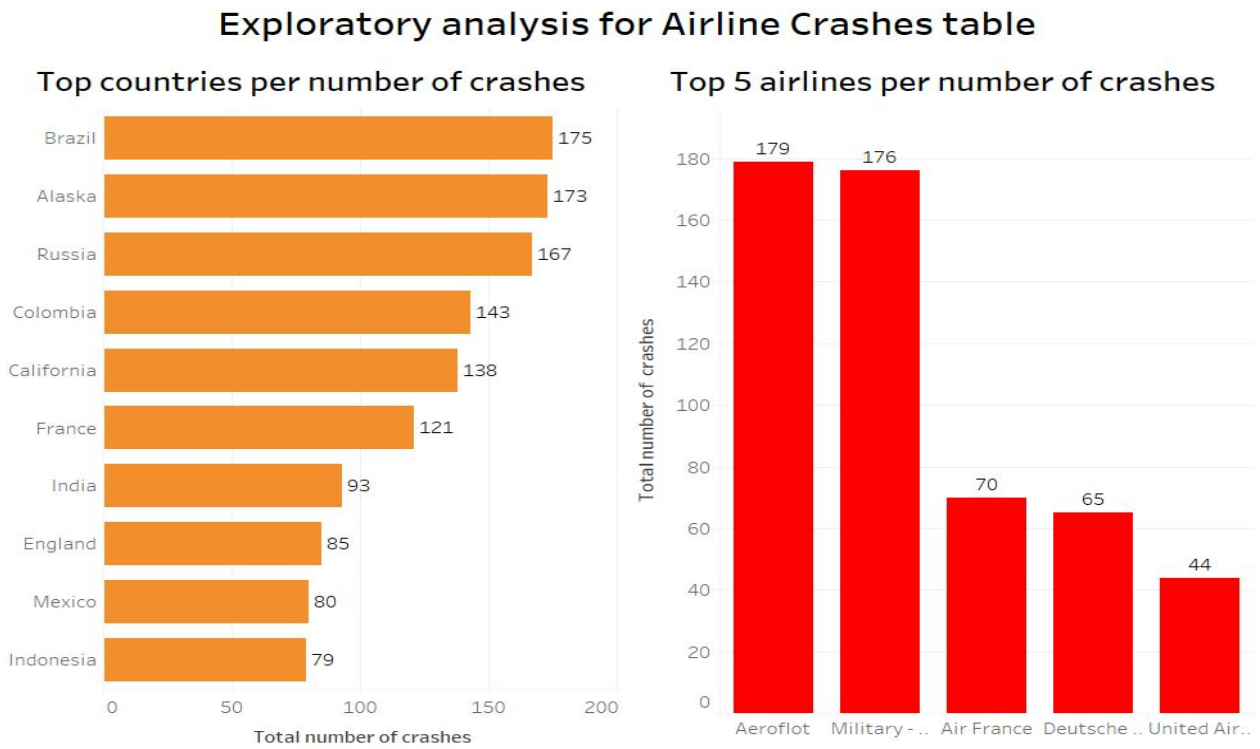


Data Preprocessing

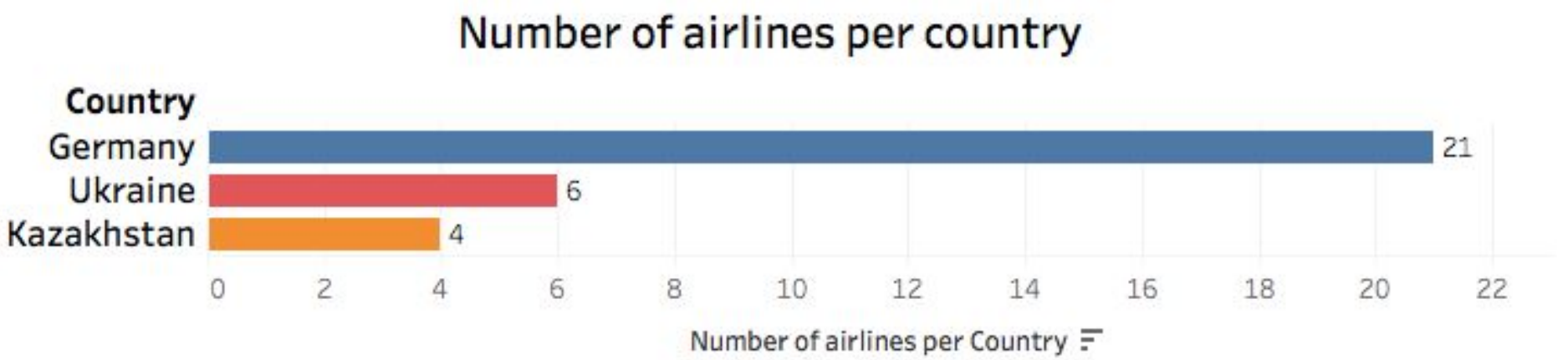


states table

airline_crashes table

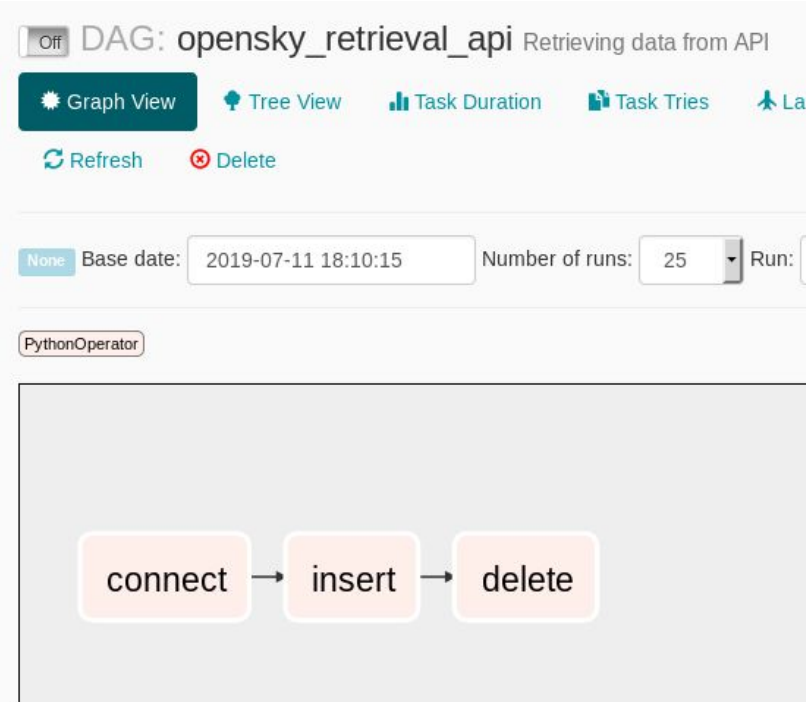


airline_codes table

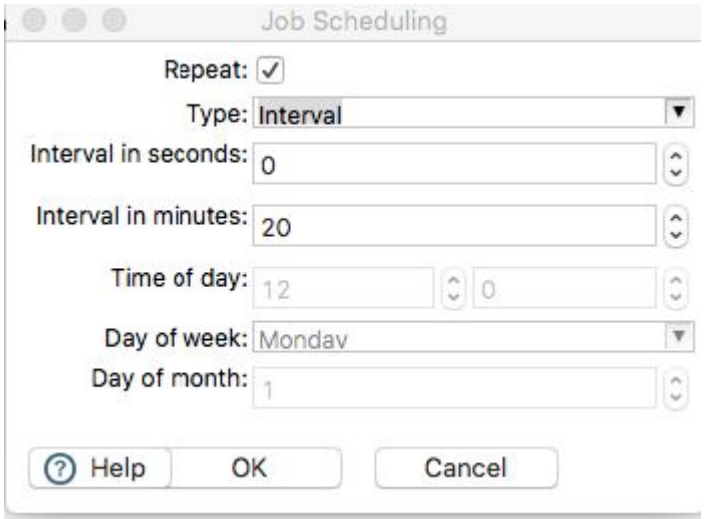


Job Scheduling

Airflow



pentaho



Data Visualization

Project Reflexions

1. Limited Capacity
2. Old flights crashes data
3. Not enough data about airports and destinations

Q&A

https://github.com/vppolina/flights_project