Decoding Aircraft Emergencies

By: Gray Hardy, Matthew Bishop, Jack Cohen, Lauren To

AGENDA

1. Background
2. Approach & Limitations
3. ETL Architecture
4. ERD Diagram
5. Data Wrangling
6. Decoding Aircraft Emergencies
7. Business Implications
8. Questions

Background

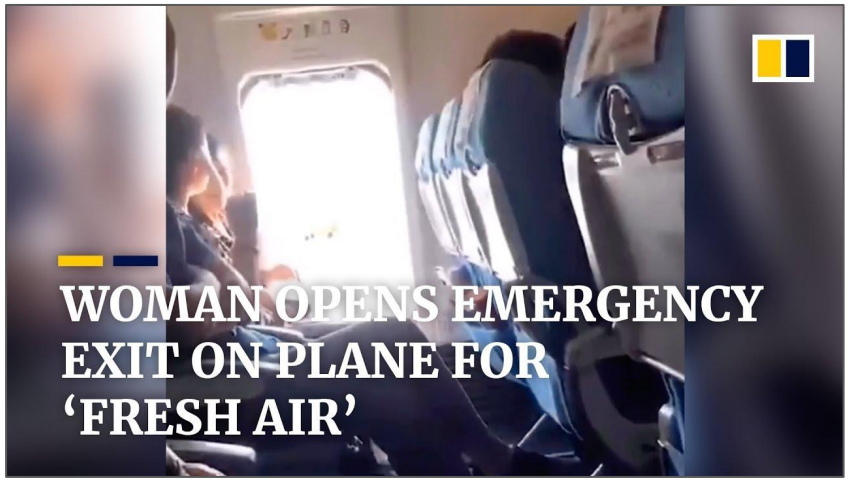
ABOUT

- Explore **in-flight emergency** air situations using squawk 7700 codes from OpenSky
- Interactive Dashboard helpful for **airlines, governing entities** like the FAA**, aerospace companies** & **airline customers** to assess and address safety concerns
  - Over **4.2 million rows of data** from csv & parquet.gz files loaded into PostgreSQL.
  - Data spans flights seen by the network's 2500+ members between 1 January 2018 and 29 January 2020.

APPROACH

1. Identify data sources and dependencies
2. Collect and clean aircraft, emergency and flight trajectory data
3. Join 3 datasets on flight_id & icao
4. Load data in PostgreSQL using SQLAlchemy
5. Create Flask App and connect routes to PostgreSQL
6. Create charts and map using Javascript libraries
7. Customize html and css for final application
8. Visualize dashboard in Heroku

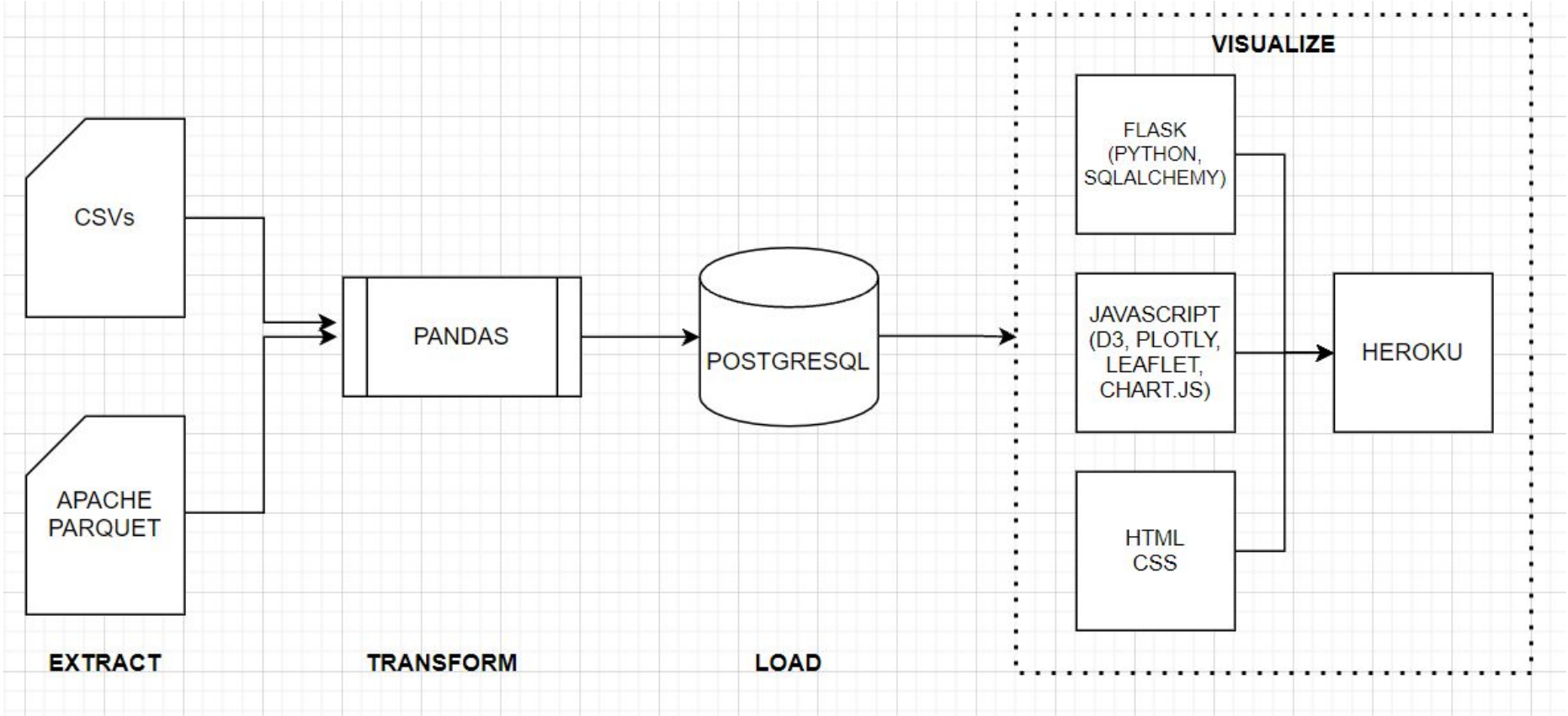
Approach



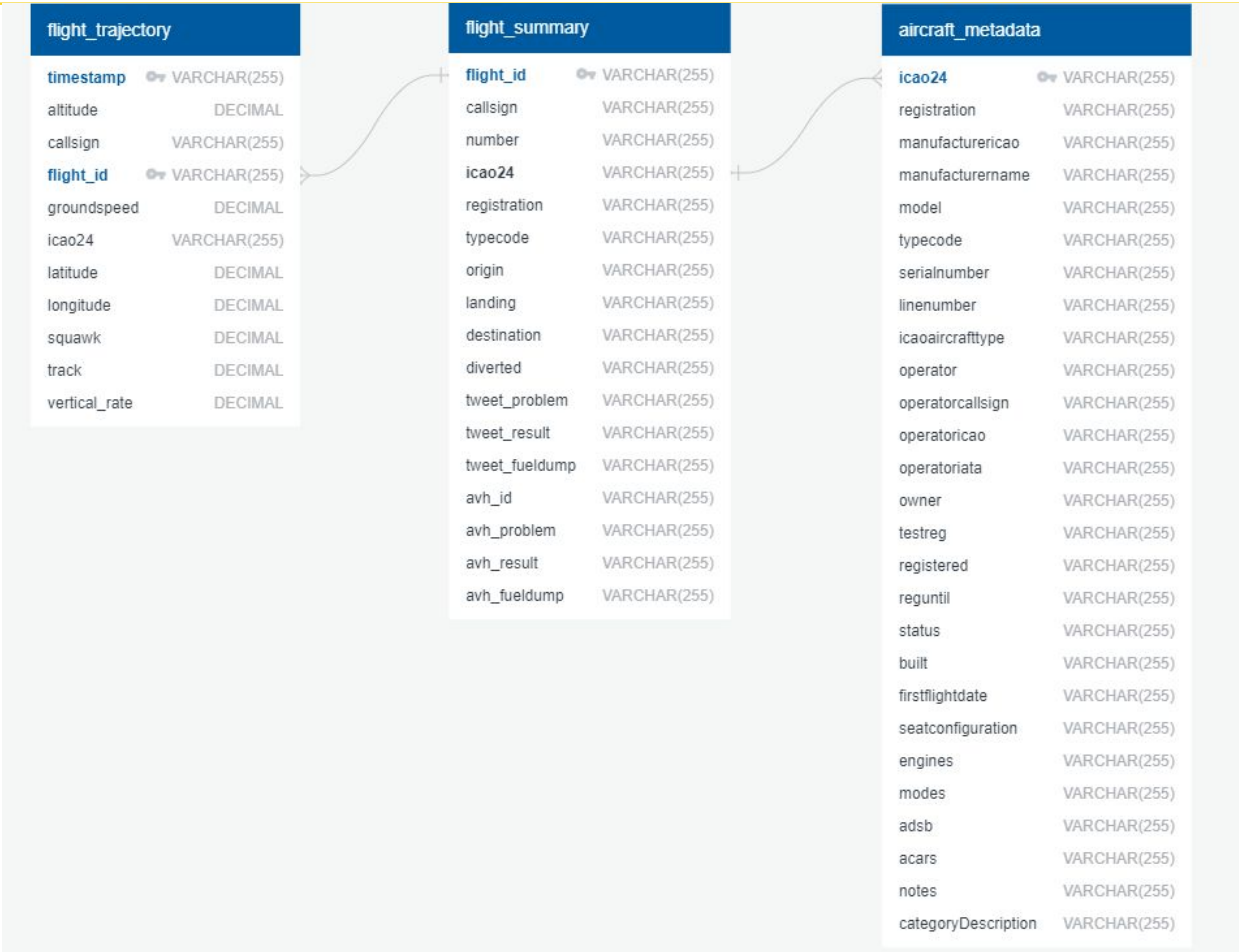
LIMITATIONS & ASSUMPTIONS

- Limited time of project
- Flight data is from Jan 2018 to Feb 2020
- Only 813 flights of squawk code 7700 data, however each flight has many rows of data
- Assume data is correct since the dataset was manually filled with research from various sources on the Internet to fill missing info from OpenSky

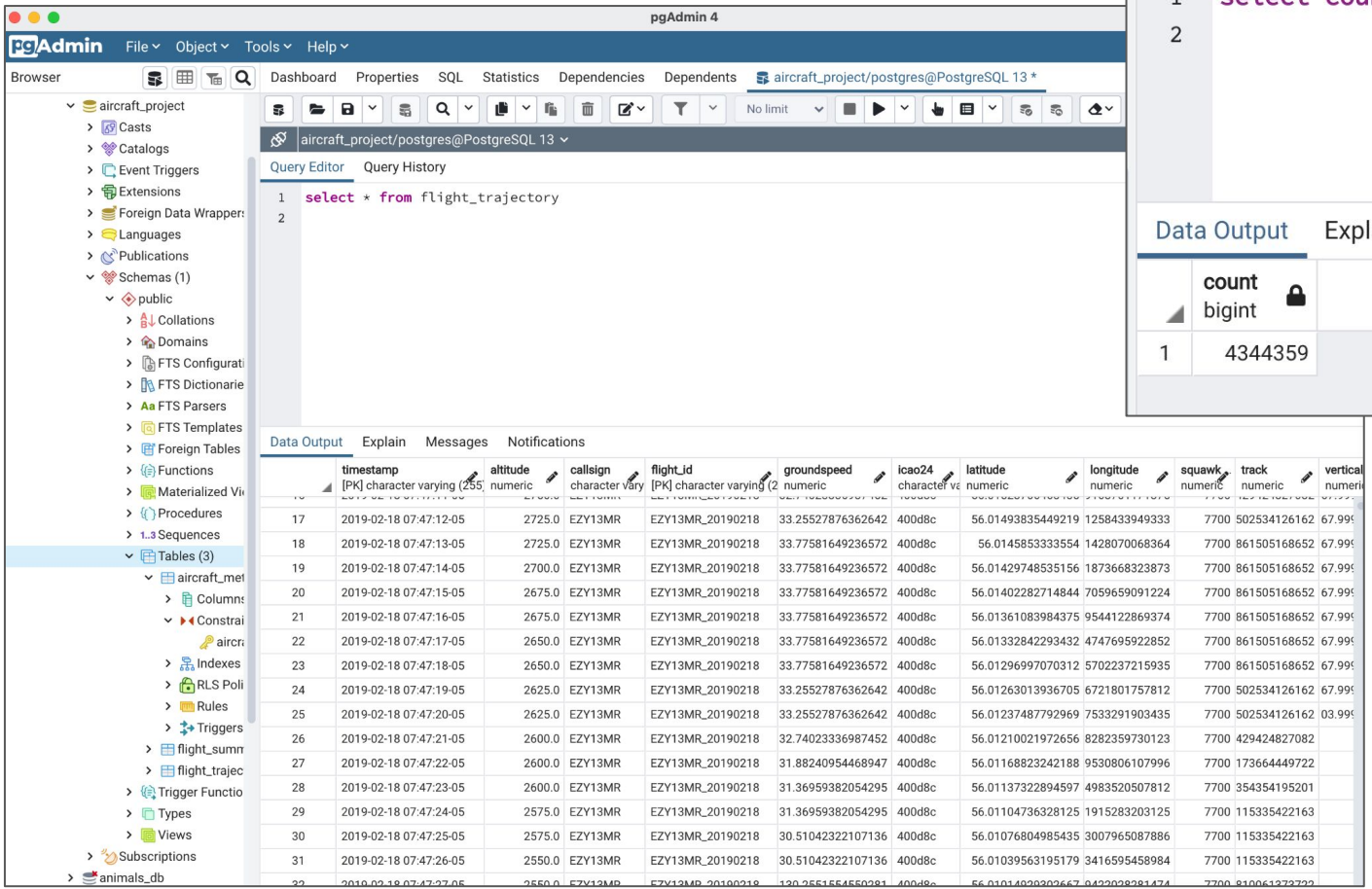
ETL Architecture

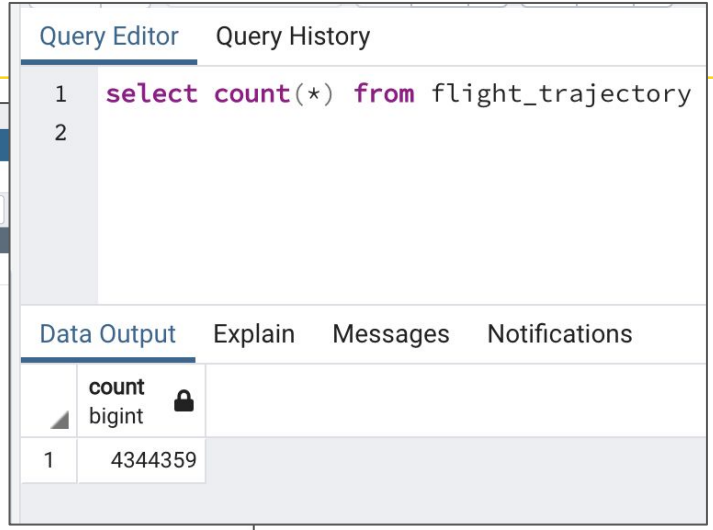


Aircraft ERD



POSTGRESQL


pgAdmin 4
pgAdmin
File
Object
Tools
Help
Browser
Dashboard
Properties
SQL
Statistics
Dependencies
Dependents
aircraft_project/postgres@PostgreSQL 13 *
No limit
aircraft_project/postgres@PostgreSQL 13
Query Editor
Query History
1 select * from flight_trajectory
2
Data Output
Explain
Messages
Notifications
aircraft_project
Casts
Catalogs
Event Triggers
Extensions
Foreign Data Wrappers
Languages
Publications
Schemas (1)
public
Collations
Domains
FTS Configurati
FTS Dictionarie
FTS Parsers
FTS Templates
Foreign Tables
Functions
Materialized Vi
Procedures
Sequences
Tables (3)
aircraft_met
Columns
Constrai
aircr
Indexes
RLS Poli
Rules
Triggers
flight_summ
flight_trajec
Trigger Functio
Types
Views
Subscriptions
animals_db
timestamp [PK] character varying (255
altitude numeric
callsign character vary
flight_id [PK] character varying (2
groundspeed numeric
icao24 character va
latitude numeric
longitude numeric
squawk numeric
track numeric
vertical
17 2019-02-18 07:47:12-05 2725.0 EZY13MR EZY13MR_20190218 33.25527876362642 400d8c 56.01493835449219 1258433949333 7700 502534126162 67.99
18 2019-02-18 07:47:13-05 2725.0 EZY13MR EZY13MR_20190218 33.77581649236572 400d8c 56.0145853333554 1428070068364 7700 861505168652 67.99
19 2019-02-18 07:47:14-05 2700.0 EZY13MR EZY13MR_20190218 33.77581649236572 400d8c 56.01429748535156 1873668323873 7700 861505168652 67.99
20 2019-02-18 07:47:15-05 2675.0 EZY13MR EZY13MR_20190218 33.77581649236572 400d8c 56.01402282714844 7059659091224 7700 861505168652 67.99
21 2019-02-18 07:47:16-05 2675.0 EZY13MR EZY13MR_20190218 33.77581649236572 400d8c 56.01361083984375 9544122869374 7700 861505168652 67.99
22 2019-02-18 07:47:17-05 2650.0 EZY13MR EZY13MR_20190218 33.77581649236572 400d8c 56.01332842293432 4747695922852 7700 861505168652 67.99
23 2019-02-18 07:47:18-05 2650.0 EZY13MR EZY13MR_20190218 33.77581649236572 400d8c 56.01296997070312 5702237215935 7700 861505168652 67.99
24 2019-02-18 07:47:19-05 2625.0 EZY13MR EZY13MR_20190218 33.25527876362642 400d8c 56.01263013936705 6721801757812 7700 502534126162 67.99
25 2019-02-18 07:47:20-05 2625.0 EZY13MR EZY13MR_20190218 33.25527876362642 400d8c 56.01237487792969 7533291903435 7700 502534126162 03.99
26 2019-02-18 07:47:21-05 2600.0 EZY13MR EZY13MR_20190218 32.74023336987452 400d8c 56.01210021972656 8282359730123 7700 429424827082
27 2019-02-18 07:47:22-05 2600.0 EZY13MR EZY13MR_20190218 31.88240954468947 400d8c 56.0116882324218 9530806107996 7700 173664449722
28 2019-02-18 07:47:23-05 2600.0 EZY13MR EZY13MR_20190218 31.36959382054295 400d8c 56.01137322894597 4983520507812 7700 354354195201
29 2019-02-18 07:47:24-05 2575.0 EZY13MR EZY13MR_20190218 31.36959382054295 400d8c 56.01104736328125 1915283203125 7700 115335422163
30 2019-02-18 07:47:25-05 2575.0 EZY13MR EZY13MR_20190218 30.51042322107136 400d8c 56.01076804985435 3007965087886 7700 115335422163
31 2019-02-18 07:47:26-05 2550.0 EZY13MR EZY13MR_20190218 30.51042322107136 400d8c 56.01039563195179 3416595458984 7700 115335422163


Query Editor
Query History
1 select count(*) from flight_trajectory
2
Data Output
Explain
Messages
Notifications
count
bigint
1 4344359

Data Wrangling

TRANSFORMATIONS

- Create SQL schemas
- Lowercase column names so that they can be loaded into postgresql
- Convert data types
- Remove NaN values and rows
- Query and filter using SQLAlchemy
- Jsonify data to power javascript visualizations

DECODING AIRCRAFT EMERGENCIES

Analyzing Aircraft Emergencies

MOST FREQUENTLY USED SQUAWK CODE

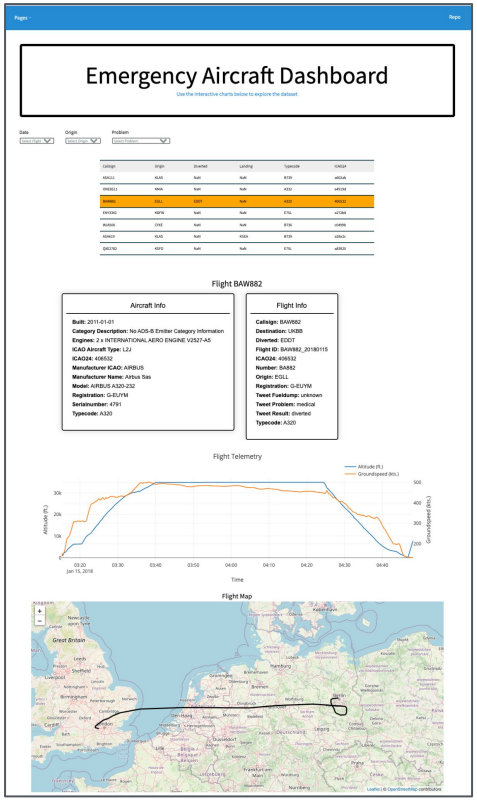
Squawk 7700 is the squawk code for a general emergency. The first emergency code is Squawk 7500. 7700 is a code that is actually fairly commonly seen by Air Traffic Control.

Data Output | Explain | Messag

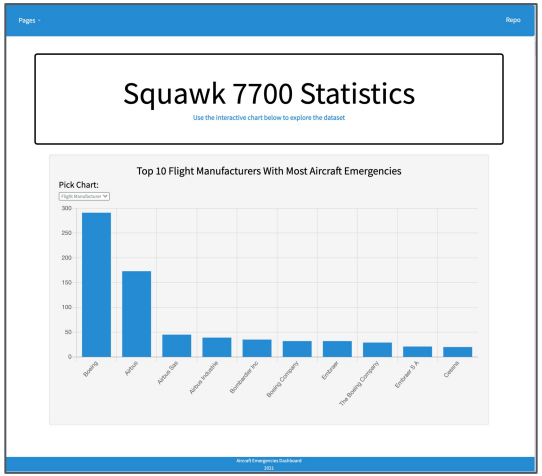
	squawk numeric	count bigint
1	7700	813
2	1000	93
3	5677	17
4	7407	10
5	5614	9

Final Application

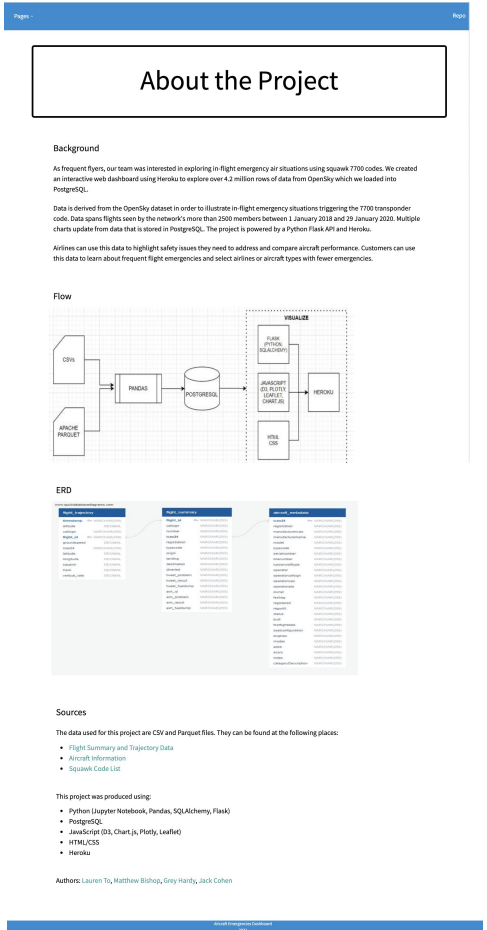
1.



2.



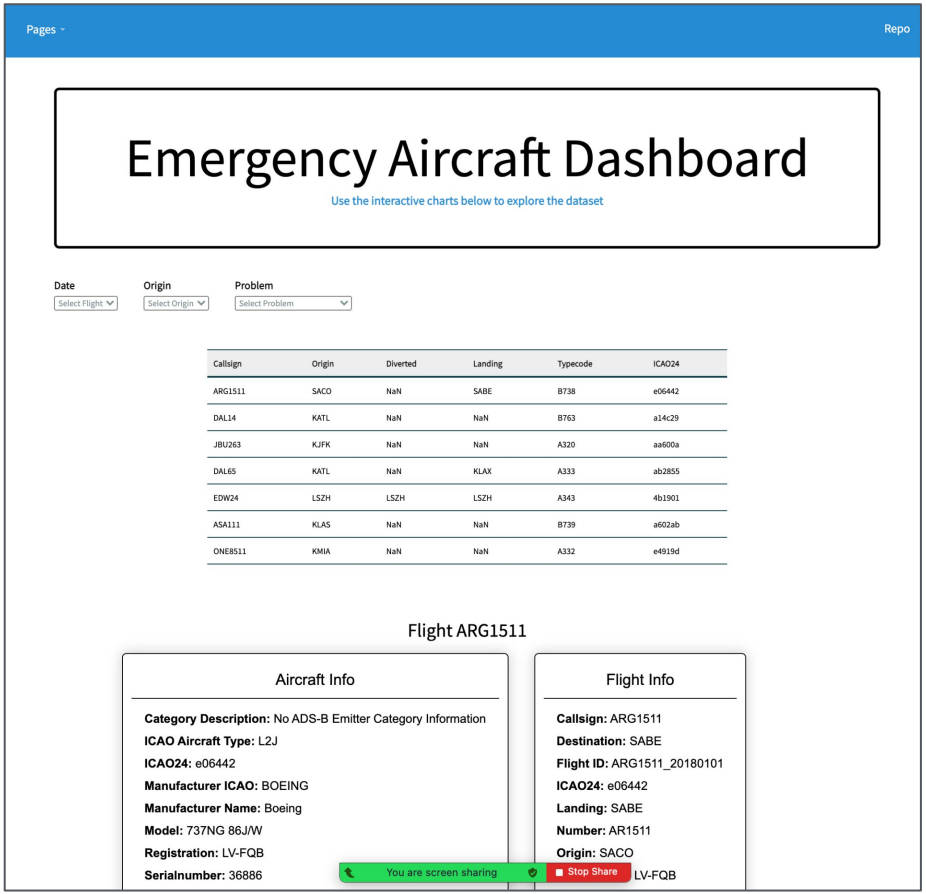
3.



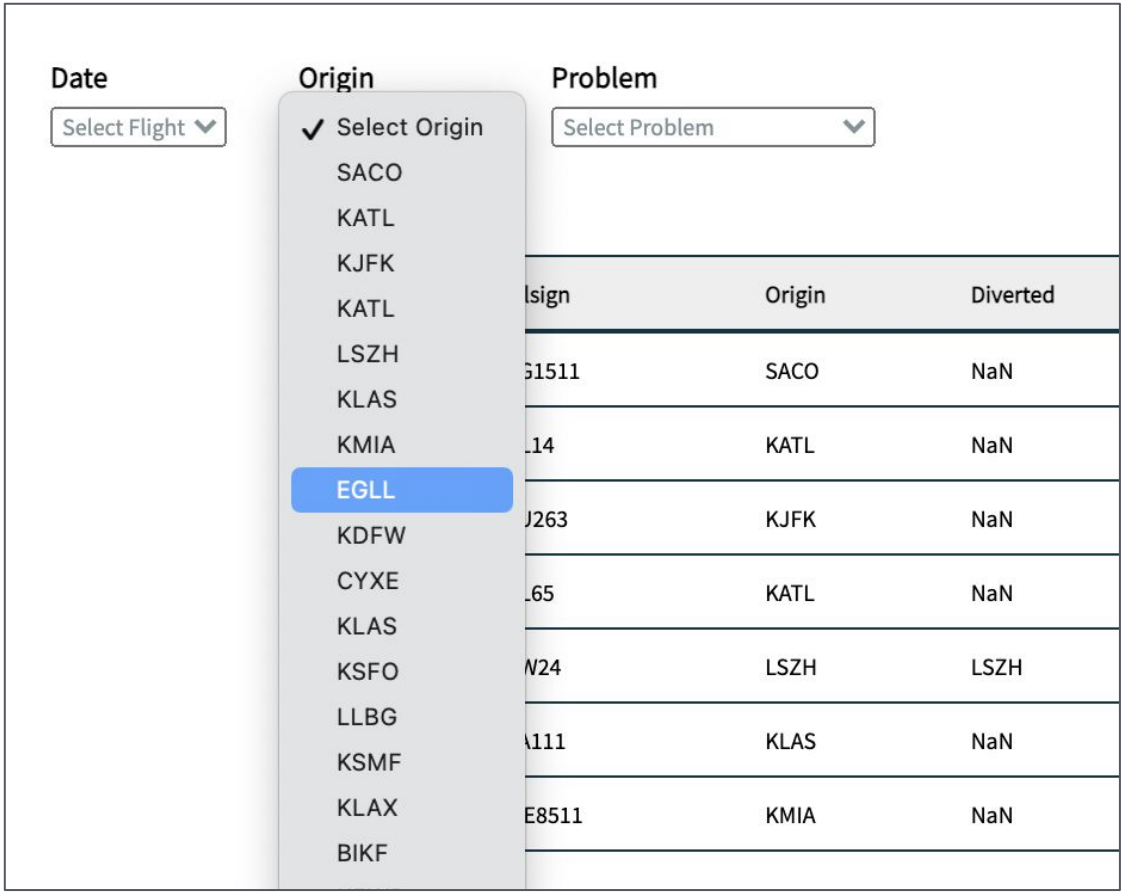
DASHBOARD LINK:

https://gtdsproject3aircraftdata.herokuapp.com/

Homepage


Pages
Repo
Emergency Aircraft Dashboard
Use the interactive charts below to explore the dataset
Date
Select Flight
Origin
Select Origin
Problem
Select Problem
Callsign Origin Diverted Landing Typecode ICAO24
ARG1511 SACO NaN SABE B738 e06442
DAL14 KATL NaN NaN B763 a14c29
JBU263 KJFK NaN NaN A320 aa600a
DAL65 KATL NaN KLAX A333 ab2855
EDW24 LSZH LSZH LSZH A343 4b1901
ASA111 KLAS NaN NaN B739 a602ab
ONE8511 KMIA NaN NaN A332 e4919d
Flight ARG1511
Aircraft Info
Category Description: No ADS-B Emitter Category Information
ICAO Aircraft Type: L2J
ICAO24: e06442
Manufacturer ICAO: BOEING
Manufacturer Name: Boeing
Model: 737NG 86J/W
Registration: LV-FQB
Serialnumber: 36886
Flight Info
Callsign: ARG1511
Destination: SABE
Flight ID: ARG1511_20180101
ICAO24: e06442
Landing: SABE
Number: AR1511
Origin: SACO
You are screen sharing
Stop Share
LV-FQB

Origin = London Heathrow (EGLL)



Diverted to Berlin-Tegel Airport (EDDT)

Callsign	Origin	Diverted	Landing	Typecode	ICAO24
EDW24	LSZH	LSZH	LSZH	A343	4b1901
ASA111	KLAS	NaN	NaN	B739	a602ab
ONE8511	KMIA	NaN	NaN	A332	e4919d
BAW882	EGLL	EDDT	NaN	A320	406532
ENY3342	KDFW	NaN	NaN	E75L	a272b8
WJA506	CYXE	NaN	NaN	B736	c0499b
ASA619	KLAS	NaN	KSEA	B739	a28a2c

Due to Medical Problem

Flight BAW882

Aircraft Info

Built: 2011-01-01

Category Description: No ADS-B Emitter Category Information

Engines: 2 x INTERNATIONAL AERO ENGINE V2527-A5

ICAO Aircraft Type: L2J

ICAO24: 406532

Manufacturer ICAO: AIRBUS

Manufacturer Name: Airbus Sas

Model: AIRBUS A320-232

Registration: G-EUYM

Serialnumber: 4791

Typecode: A320

Flight Info

Callsign: BAW882

Destination: UKBB

Diverted: EDDT

Flight ID: BAW882_20180115

ICAO24: 406532

Number: BA882

Origin: EGLL

Registration: G-EUYM

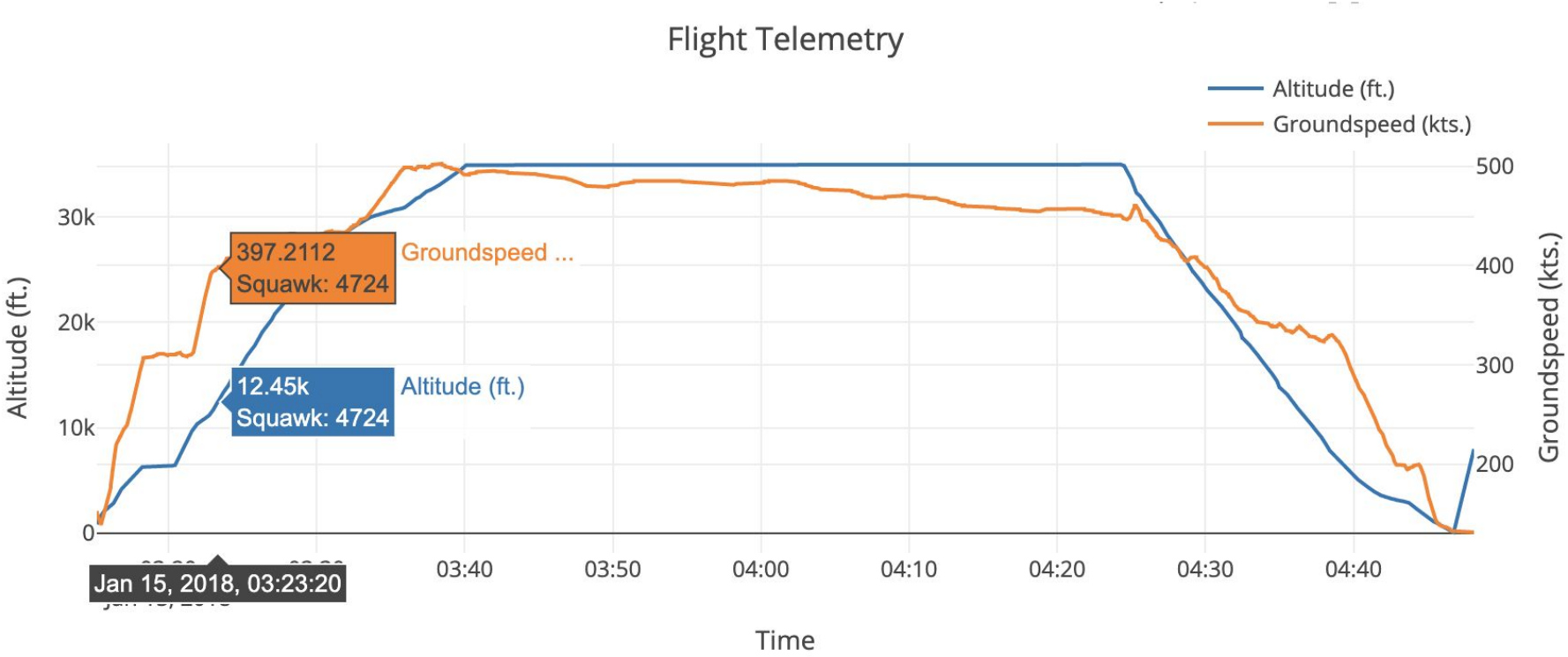
Tweet Fueldump: unknown

Tweet Problem: medical

Tweet Result: diverted

Typecode: A320

Rapid Altitude Loss

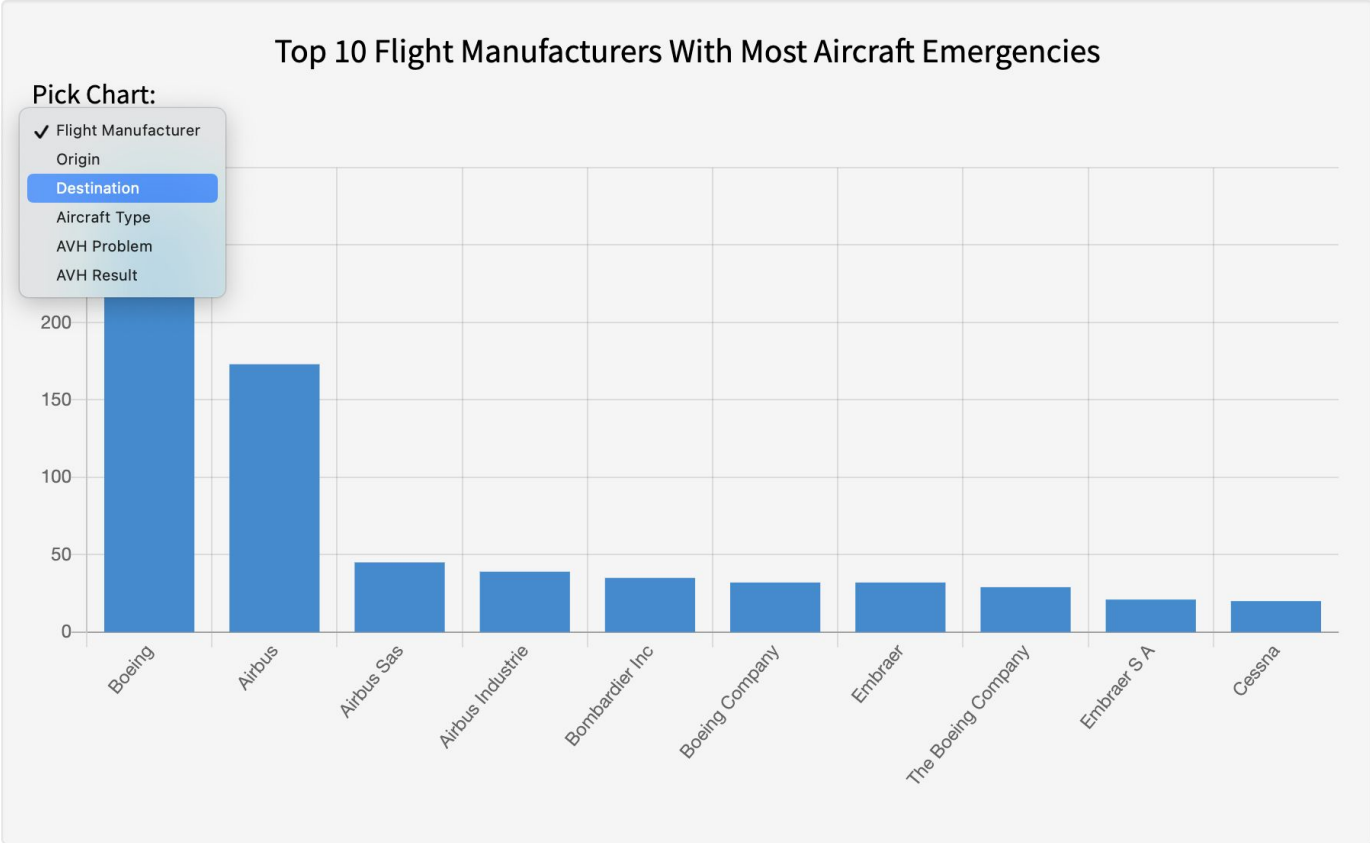


Circle Back on Path

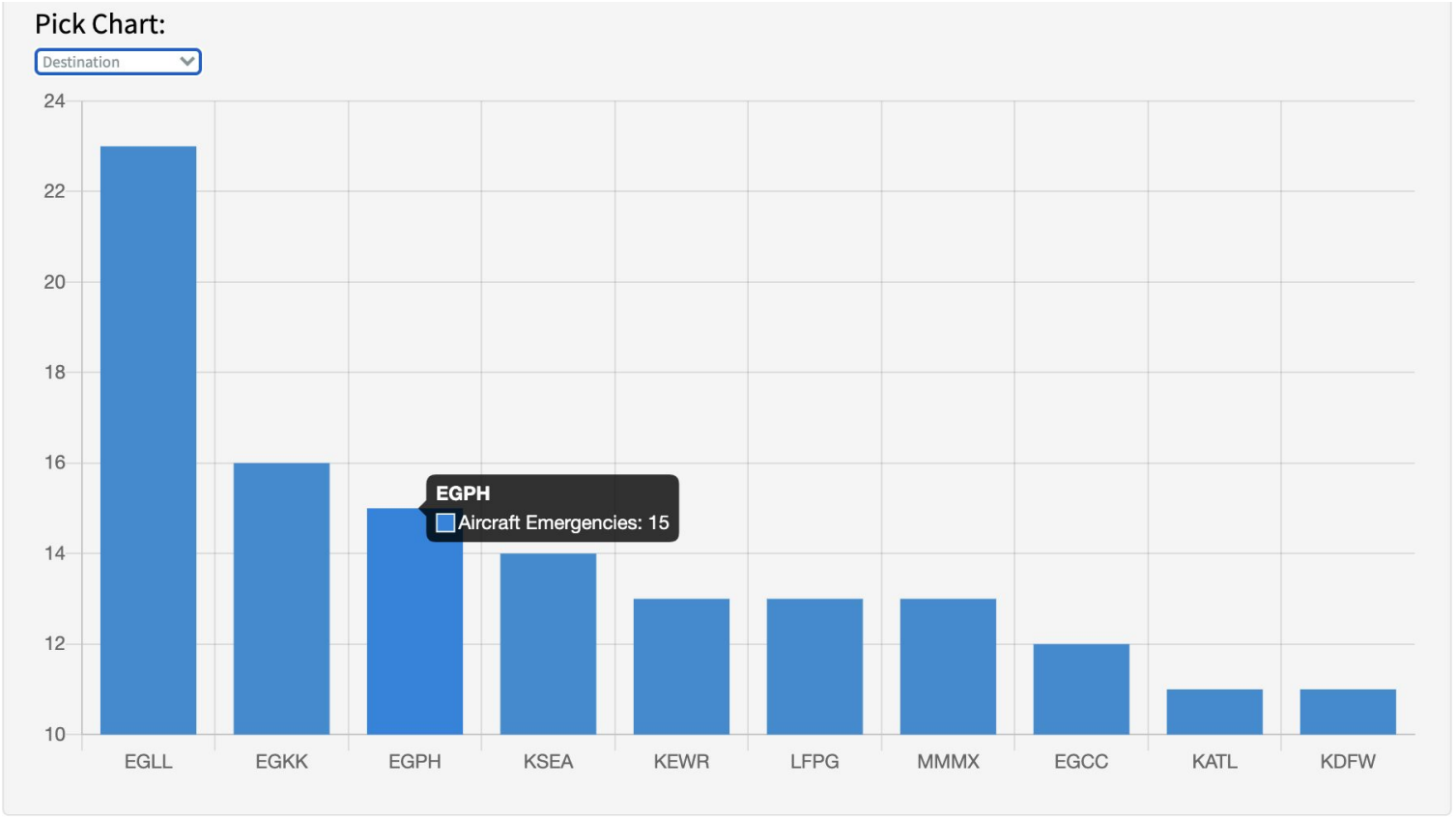
Flight Map

DECODING AIRPLANE EMERGENCIES [PART 2]

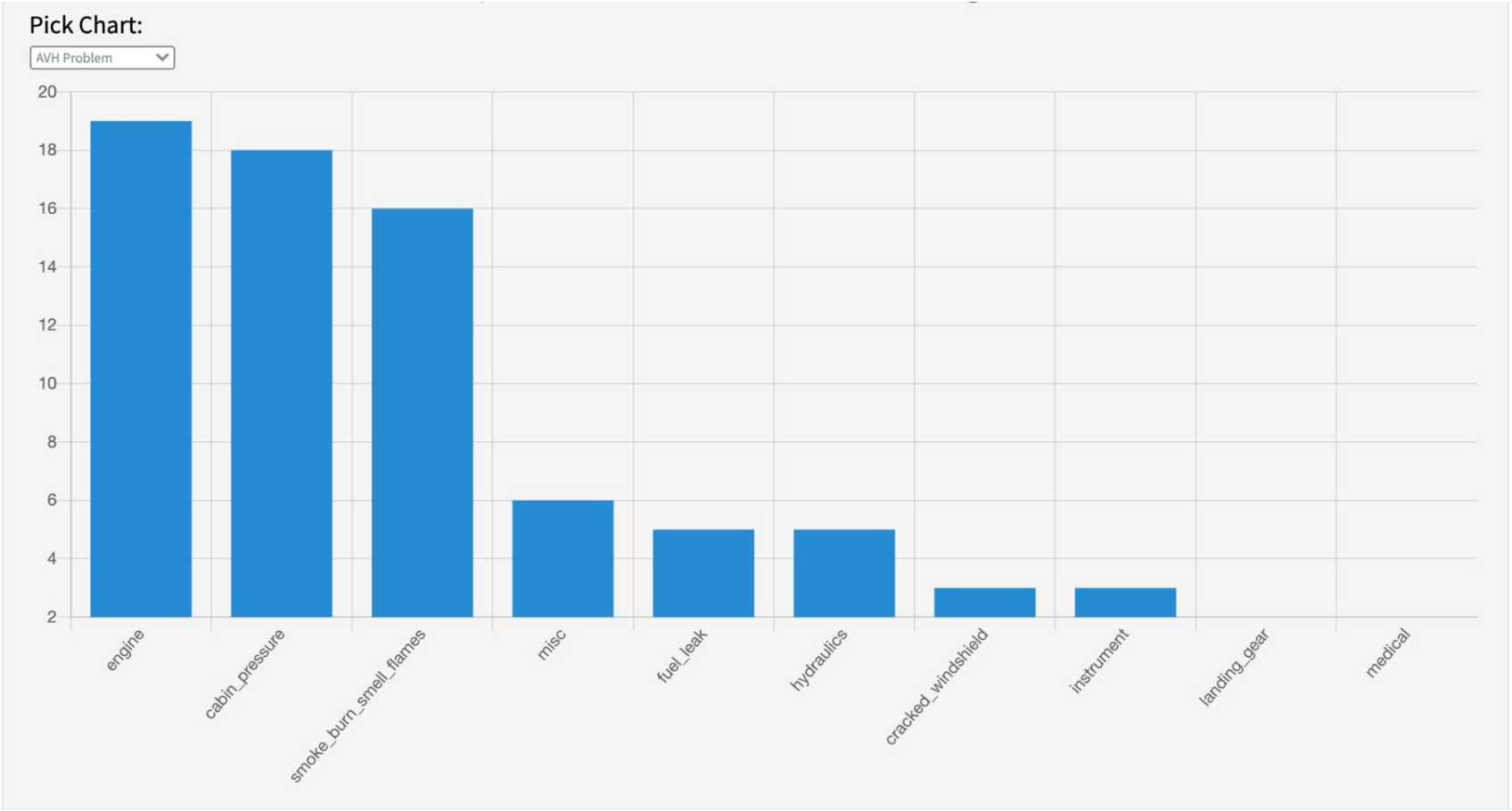
Planes manufactured by Boeing have the most emergencies.



Planes enroute to Heathrow (EGLL) experience the most emergencies.



Engine problems are the most common issues, followed by cabin pressure and smoke, burn, smell flames,.



Conclusion

"The mission of the FAA is to provide the safest, most efficient aerospace system in the world."

BUSINESS IMPLICATIONS

- Airlines can use this data to highlight safety issues they need to address and compare aircraft performance
- Help governing entities and aerospace companies like the FAA, etc. determine where source of problems are coming from
- Customers can use this data to learn about frequent flight emergencies and select airlines or aircraft types with fewer emergencies

QUESTIONS?