



AI for warning messages (NOTAMs) at SWISS international airlines

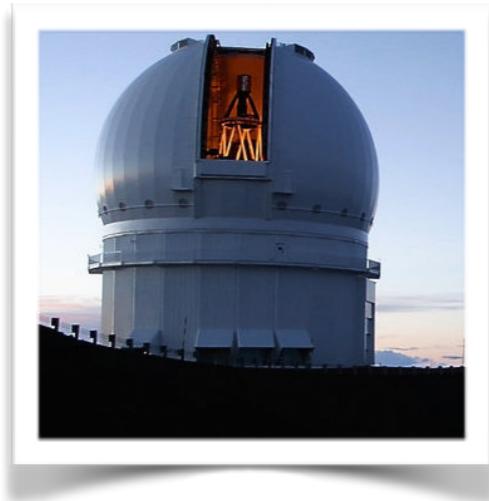
Jean Coupon
October 17, 2018

Data Science / Batch 4 / July 30 to October 19, 2018



{ Propulsion }

Who am I?



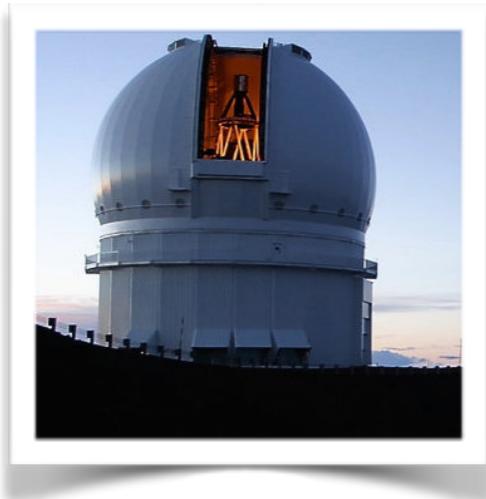
{Propulsion}

Ph.D. in Astrophysics (2009)

4 years of Postdocs
in Japan and Taiwan

5 years at the University
of Geneva as a researcher

Who am I?



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Data Science

5 years at the University
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New opportunities

Business-driven challenges

Warning messages in aviation

How to let pilots know of any abnormal situation?
(closed airspace, instrument failures, obstacles, etc.)



Warning messages in aviation

How to let pilots know of any abnormal situation?
(closed airspace, instrument failures, obstacles, etc.)

NOTAM (Notice to Airmen):

- Short text from aviation authorities
- Pilots are responsible for collecting the relevant ones
- For commercial pilots: usually gathered and filtered by the airline

NOTAM format

Code (location, time, basic description)

A0960/18 NOTAMN

Q)KZJX/QRACA/IV/NBO/W/000/999/2745N08452W115

A)KZJX

B)1806151030

C)1806151430

E)A MIL MISSILE LAUNCH WILL BE CONDUCTED IN
THE GULF OF MEXICO

Text in English (free form)

Challenge

At SWISS, 3000 NOTAMs **manually** processed per day
(~1M/year, and growing)

3000 NOTAMs/day



1500 important



10-50/flight



Pilots

Goals

Help everyone in the process to make **informed decisions**,
save time with obvious NOTAMs (money),
spend more time on uncertain cases (safety)

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1. Label the NOTAMs



2. Sort by importance



Text	Label	Importance
NOTAM1	Runways	97%
NOTAM2	Runways	80%
NOTAM3	Obstacles	79%
NOTAM4	Instruments	20%
NOTAM5	Obstacles	15%

1. NOTAM labeling

Unsupervised machine learning approach* in 3 steps:

- a. transform words into a computer representation:
= natural language processing (**NLP**)
- b. Find similarities between NOTAMs (**clustering**)
- c. Do **labeling** by hand

*developed a version-controlled software in Python
using open source libraries (Scikit-Learn, Gensim)

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RWY 07/25 CLSD

CRANE OPR PSN 513333.67N
0004220.59E

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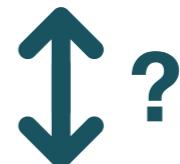
→ [-0.018, -0.065, ..., -0.935, -0.640]

RWY 07/25 CLSD

→ [-0.056, -0.055, ..., -0.002, -0.034]

CRANE OPR PSN 513333.67N
0004220.59E

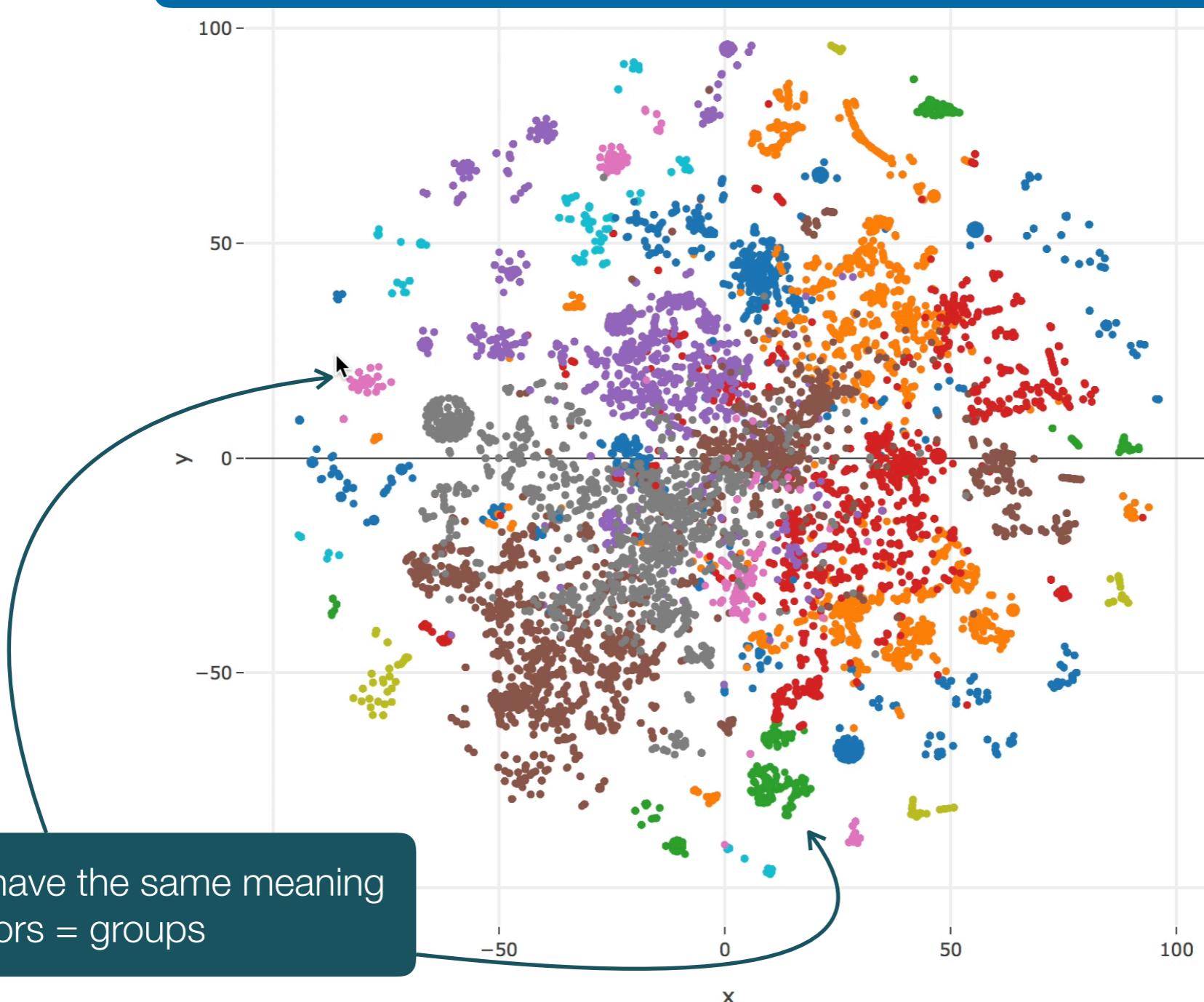
→ [-0.087, -0.043, ..., -0.123, -0.345]



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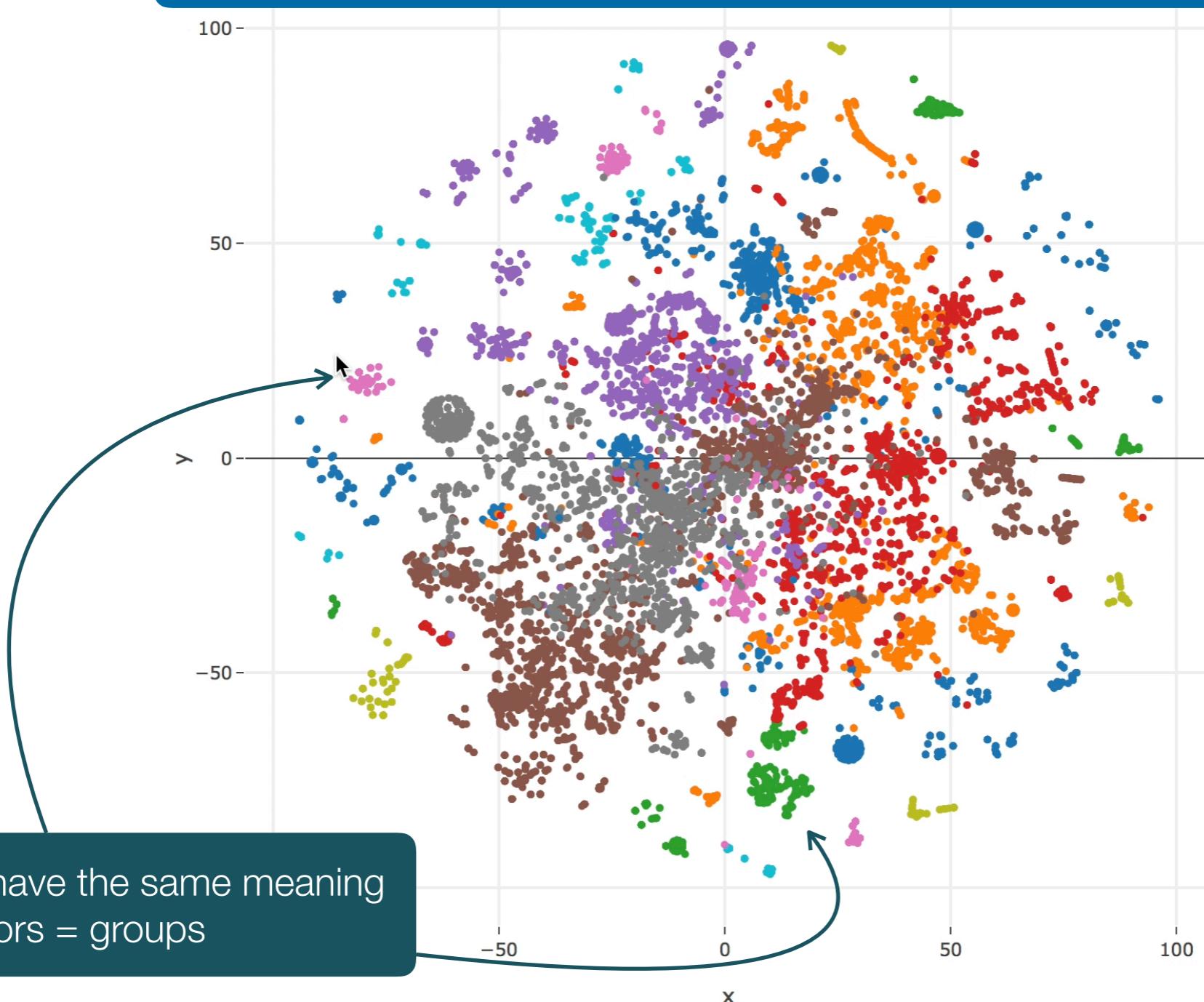
1. NOTAM labeling

Artificial representation of 1 week of NOTAMs
1 point = 1 NOTAM



1. NOTAM labeling

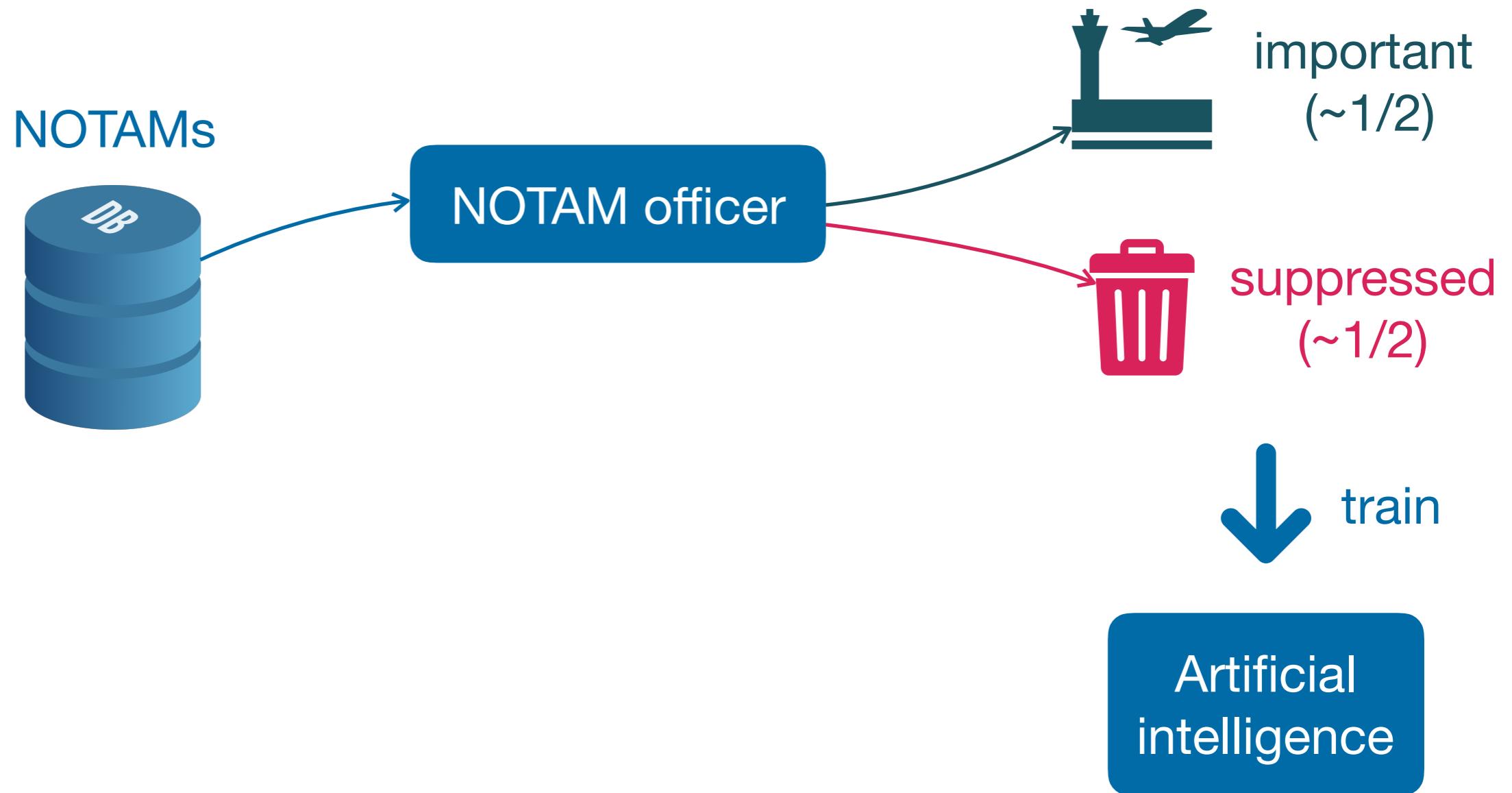
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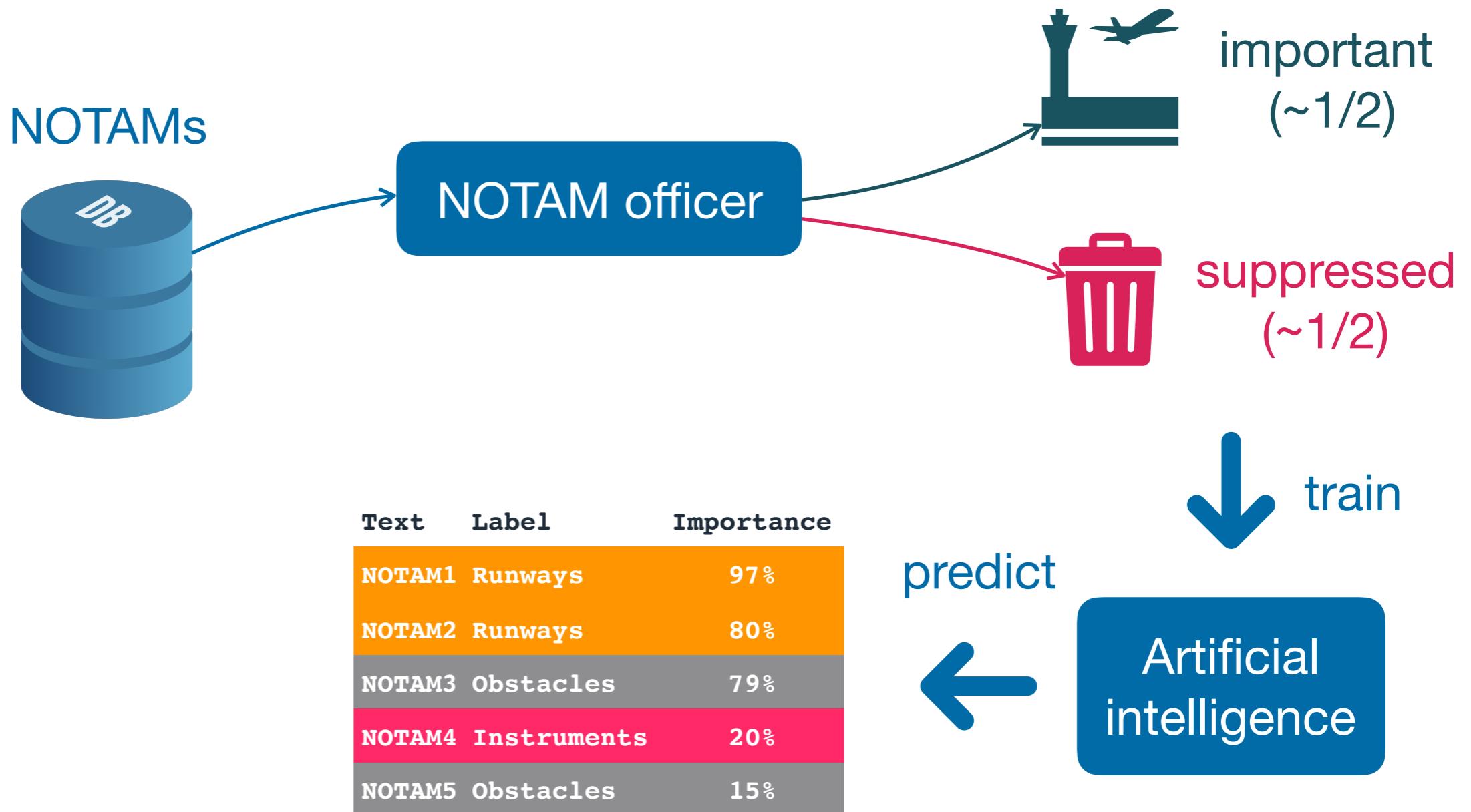
2. NOTAM importance classification



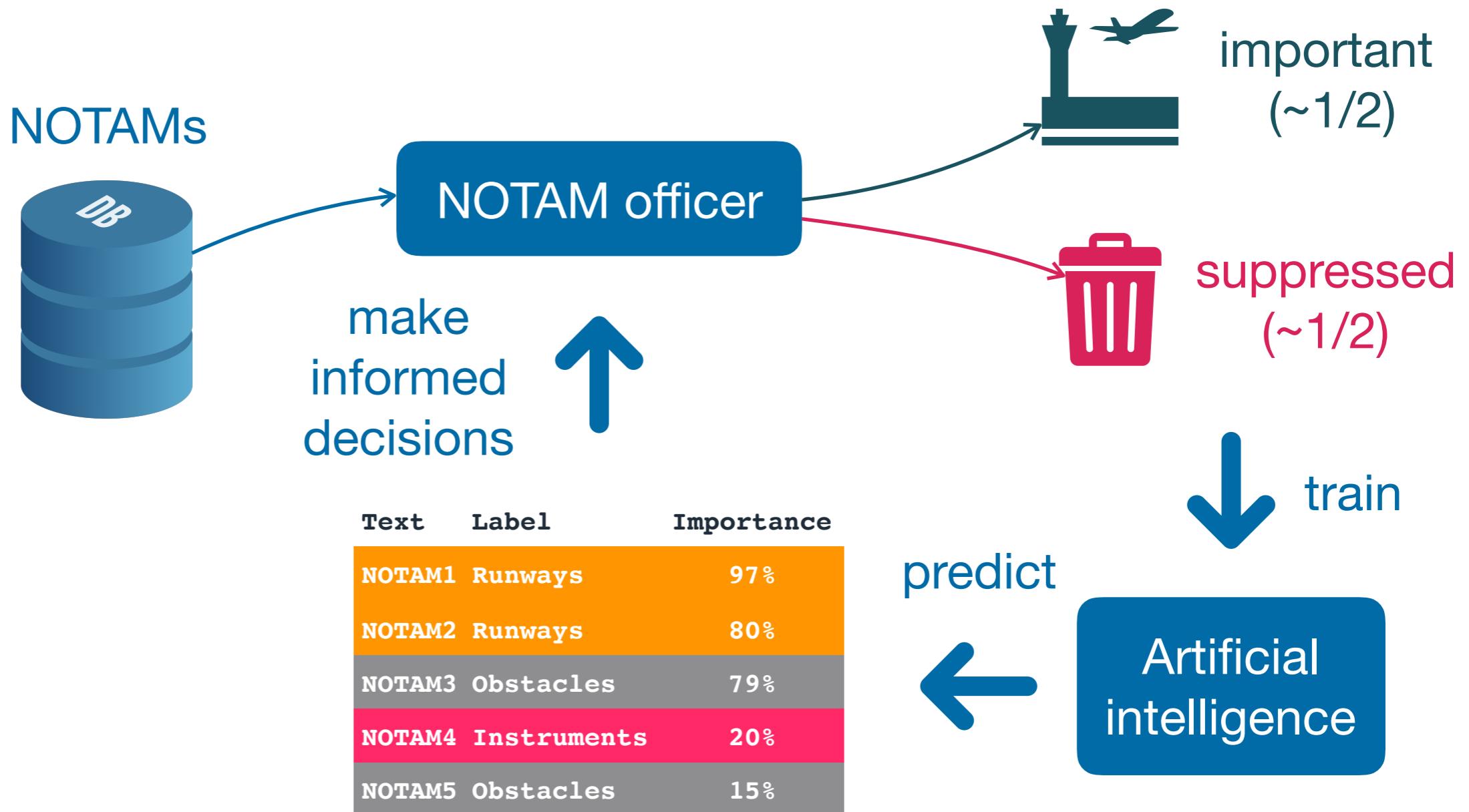
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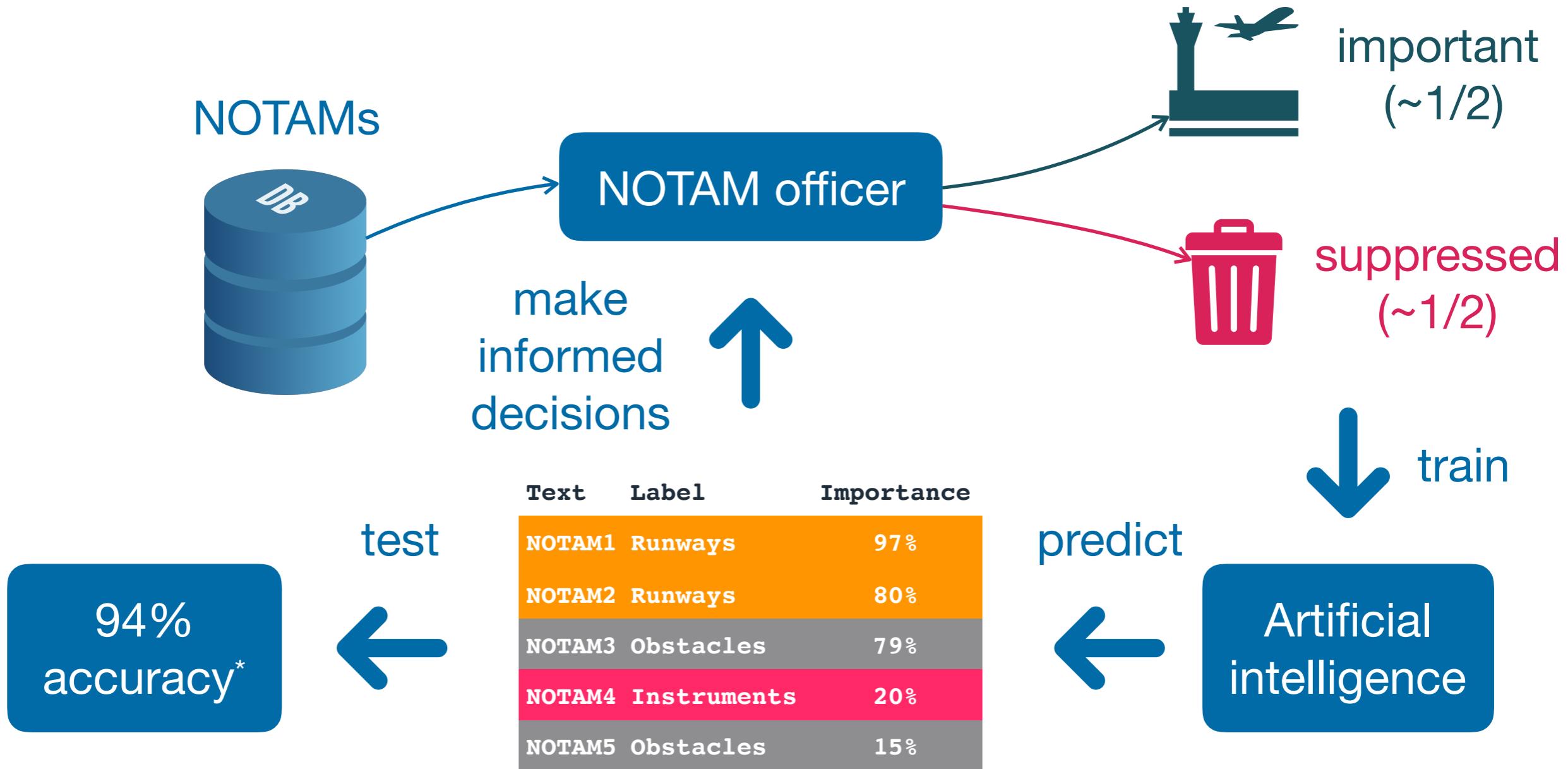
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2. NOTAM importance classification



*neural network trained
with 1 month worth of data
(96% recall on important NOTAMs)

Future

More NOTAMS (used only 1 month worth of data)

Model tuning: customized labeling, better accuracy

User feedback (pilots, NOTAM officers): how to help?

Thank you!



- Pawel Kampczyk
- Joao Banha
- Soeren Linau



{**Propulsion**}

- Nitin Kumar
- Laurent Meyer
- Sebastian Mattmüller
- Colin, Shekhar, Nicolas, Cesar
- Santi, Francisco, Dimitris, Clemente, Raphaël, Satrajit, Corey, Gilles, Olivia and Jeremy and Fouad



github.com/jcoupon



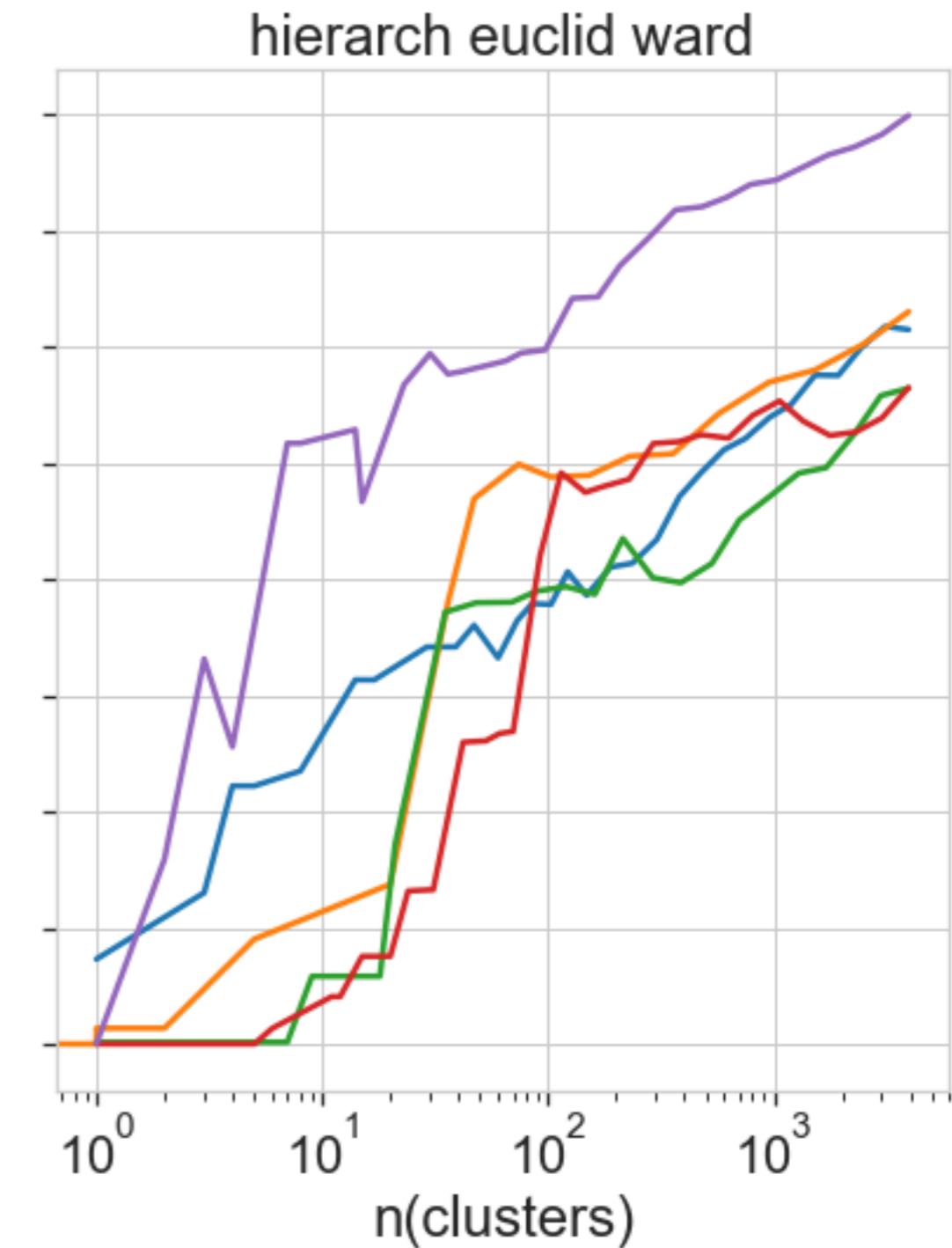
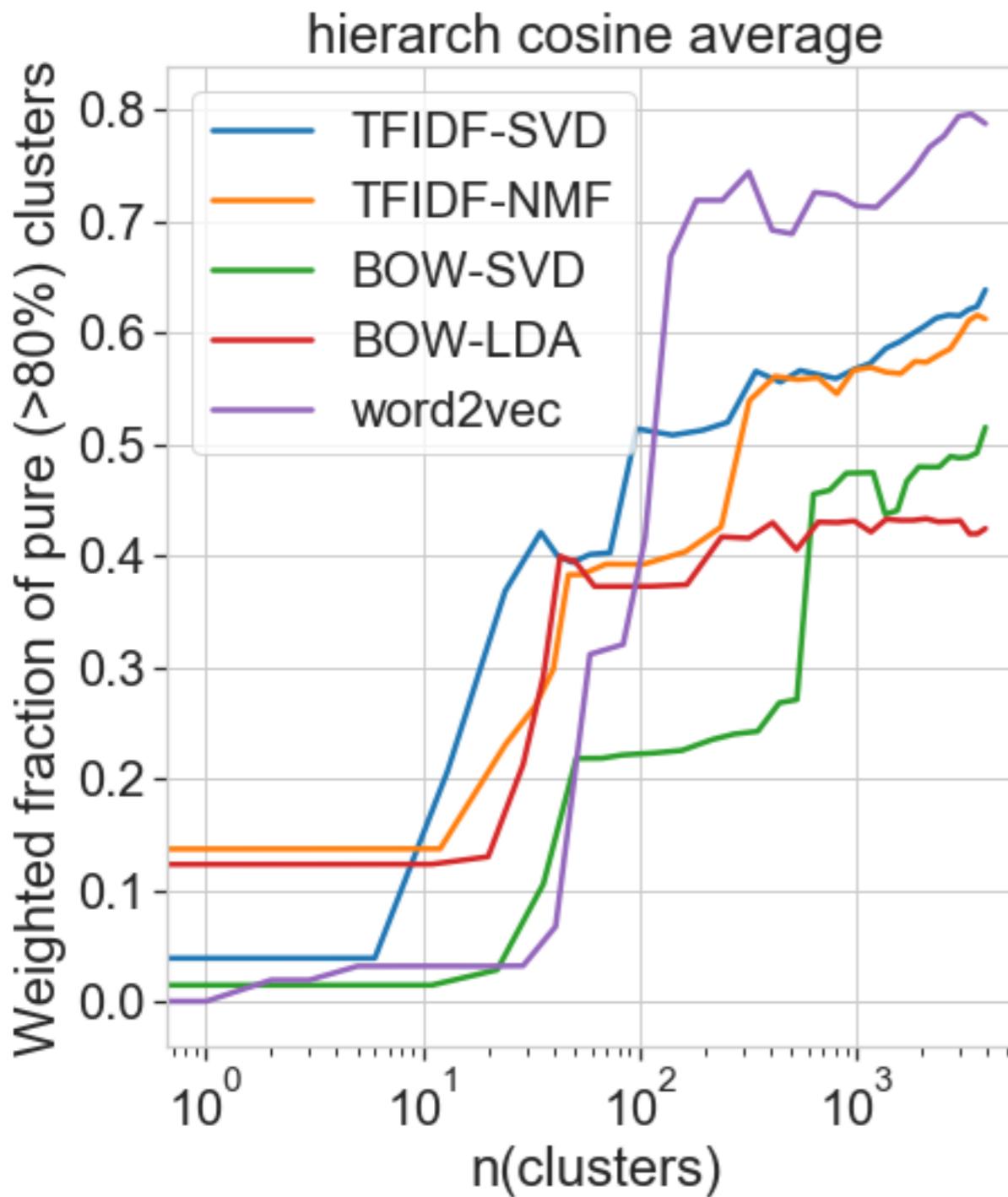
jean.coupon@gmail.com



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Additional material

Cluster purity



Most frequent words

```
array(['num', 'coord', 'rwy', 'twy', 'clsd', 'area', 'fl', 'acft', 'btn',
       'avbl', 'wi', 'ft', 'nm', 'act', 'radius', 'ad', 'ils', 'aip',
       'gps', 'mil', 'mhz', 'dme', 'rte', 'flt', 'activated', 'amsl',
       'wip', 'airspace', 'wet', 'flw', 'exc', 'obs', 'svc', 'place',
       'km', 'fm', 'agl', 'vor', 'ref', 'sfc', 'dct', 'pct', 'info',
       'raim', 'restricted', 'rmk', 'maint', 'cat', 'radar', 'amdt',
       'tempo', 'atc', 'psn', 'ep', 'apch', 'lgt', 'loc', 'hr', 'freq',
       'ops', 'twr', 'rnav', 'circle', 'min', 'expect', 'proc', 'tfc',
       'ats', 'notam', 'opr', 'vectoring', 'danger', 'detection', 'end',
       'centre', 'ctl', 'line', 'jun', 'fir', 'point', 'fault', 'nr',
       'ch', 'tso', 'hours', 'outages', 'obst', 'alt', 'enr', 'ausots',
       'sup', 'civ', 'coor', 'dep', 'centered', 'points', 'equipped',
       'frng', 'departure', 'air'], dtype='<U10')
```

Classifier results

```
N=19710, TP=10226, TN=8300, FP=745, FN=439
Precision: 0.9321, recall: 0.9588, accuracy: 0.9399
      precision    recall   f1-score   support
      False        0.95     0.92     0.93      9045
      True         0.93     0.96     0.95     10665
avg / total       0.94     0.94     0.94     19710
```