

AI for warning messages (NOTAMs) at SWISS international airlines

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October 17, 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



Data Science

New opportunities

Business-driven challenges

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
- Since 1921! Used to be sent by landline/radio
- 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



NOTAM officer

1500 important



Flight dispatcher



70-150/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)



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:

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

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RWY 07/25 CLSD

CRANE OPR PSN 513333.67N
0004220.59E

→ $[-0.018, -0.065, \dots, -0.935, -0.640]$

→ $[-0.056, -0.055, \dots, -0.002, -0.034]$

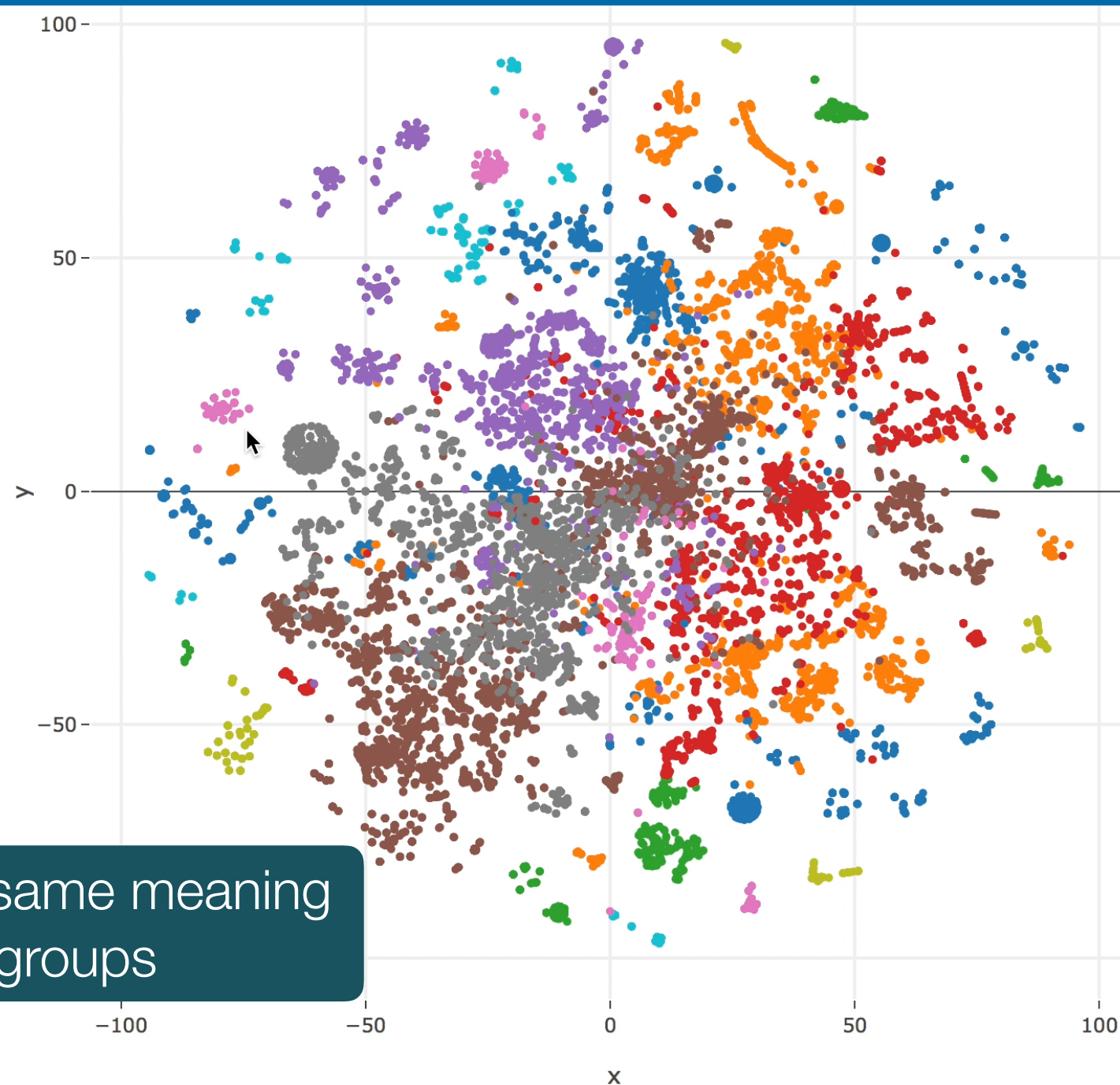
→ $[-0.087, -0.043, \dots, -0.123, -0.345]$



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

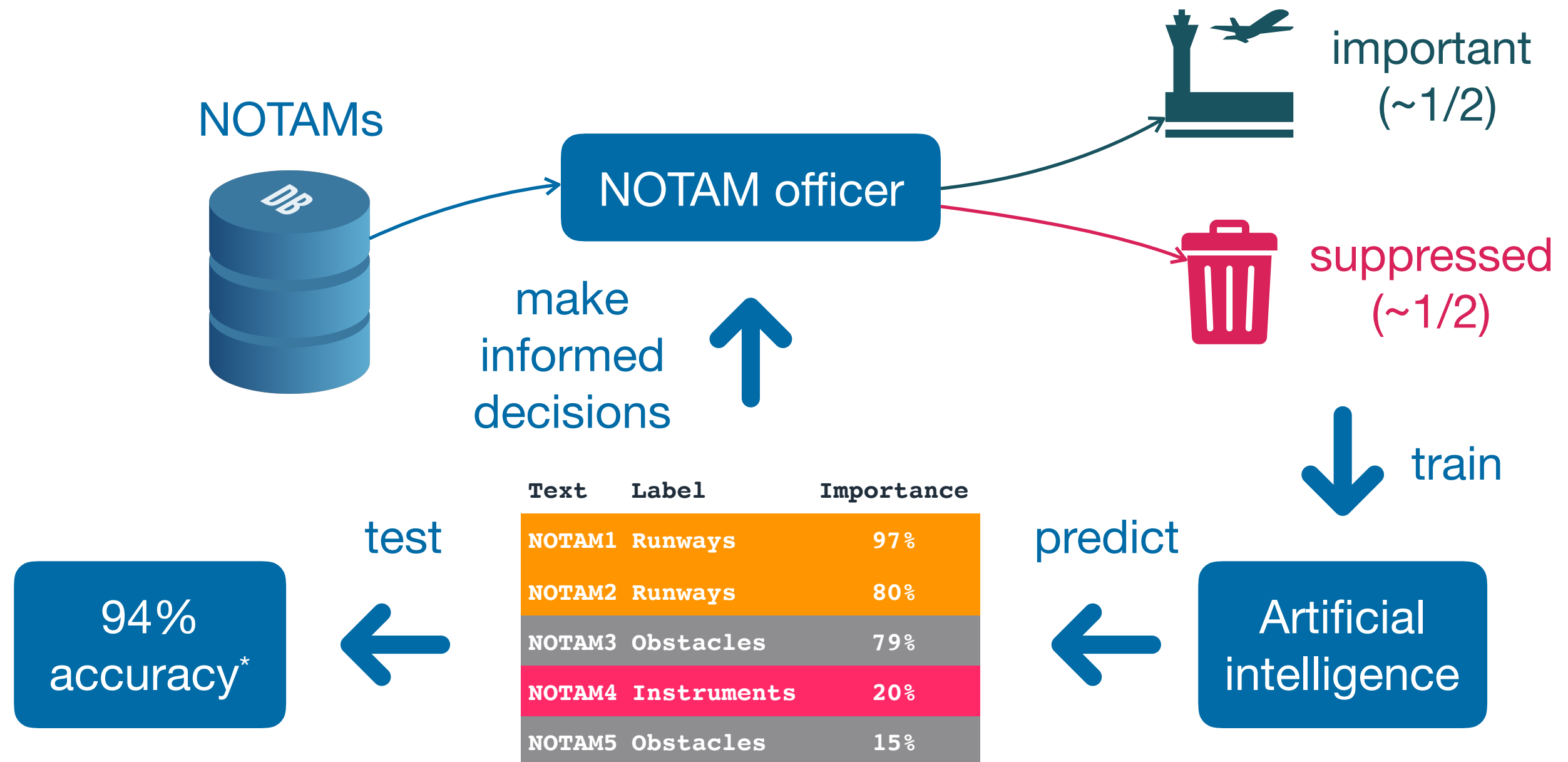
1. NOTAM labeling

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



Close points -> same meaning
colors = groups

2. NOTAM importance classification



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

Summary & outlook

Summary:

- Processing NOTAMs is tedious for SWISS
- Wrote an AI system to label and assist classification
- Potential to save time (money) while keeping safety high

Outlook:

- Train with more NOTAMs (millions available)
- 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, Sekhar, Nicolas, Cesar, and Laurent H.
- Santi, Francisco, Dimitris, Clemente, Raphaël, Satrajit, Corey, Gilles, Olivia, Jeremy, Lukas and Fouad



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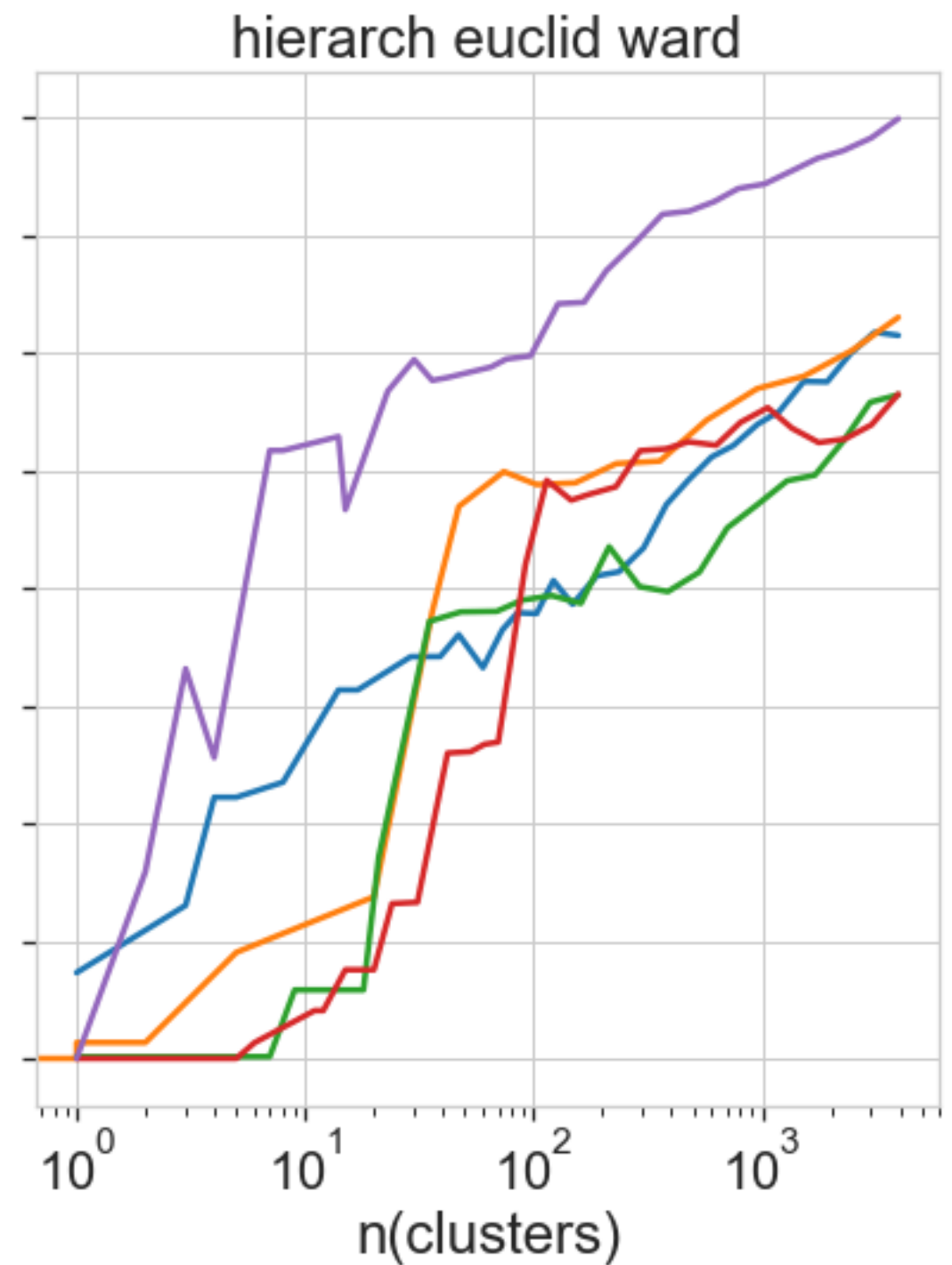
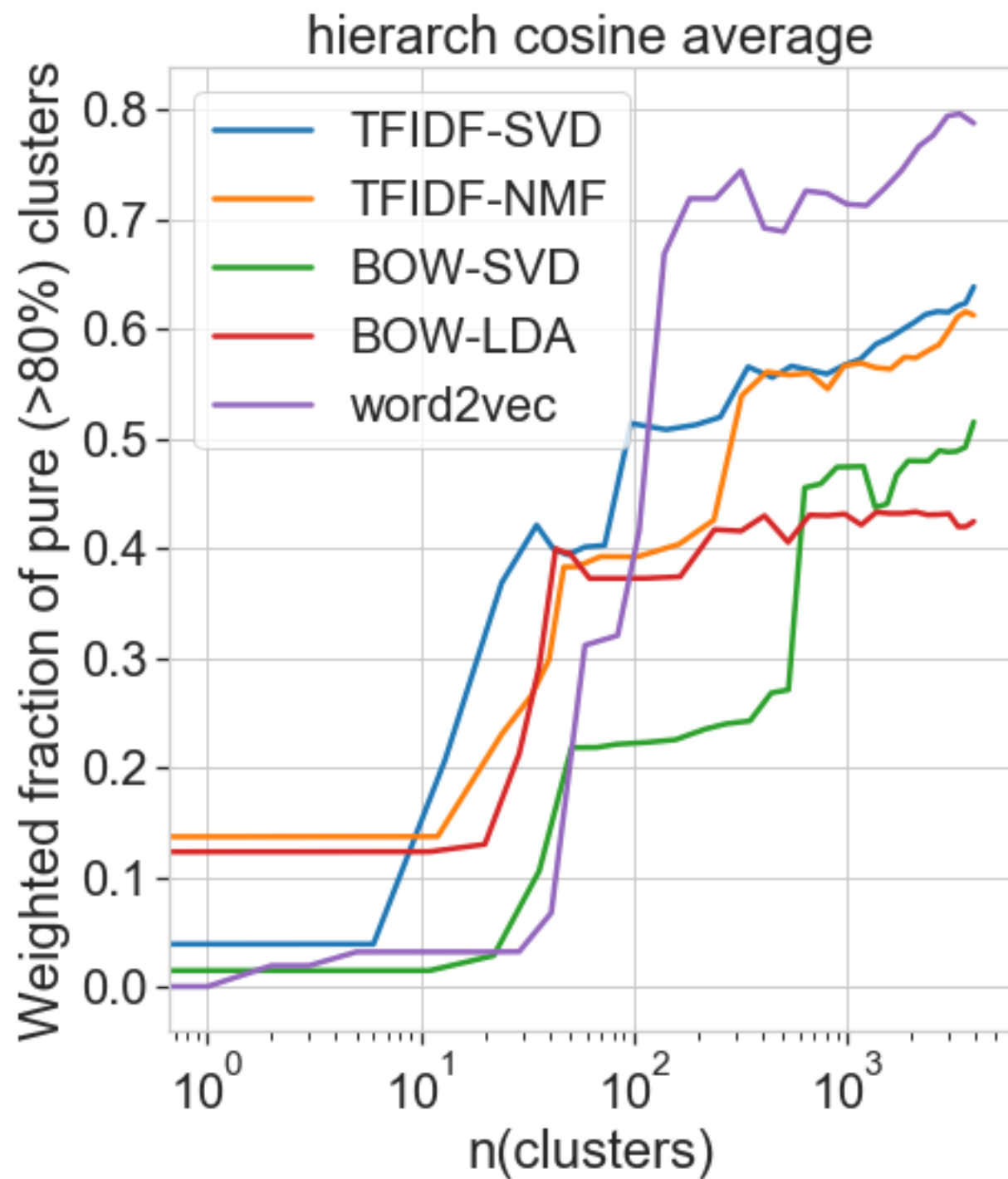
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github.com/jcoupon

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