



A Brief Introduction to AI/ML Application for Air Traffic Management Data at NASA Ames

Jacqueline Almache, Stephen Clarke, Satvik Kumar, Swetha Rajkumar, Shyam Nuggehalli, Tej Sathe, Jordan Majoros, Aarav Noronha

Mentor: Raj Pai

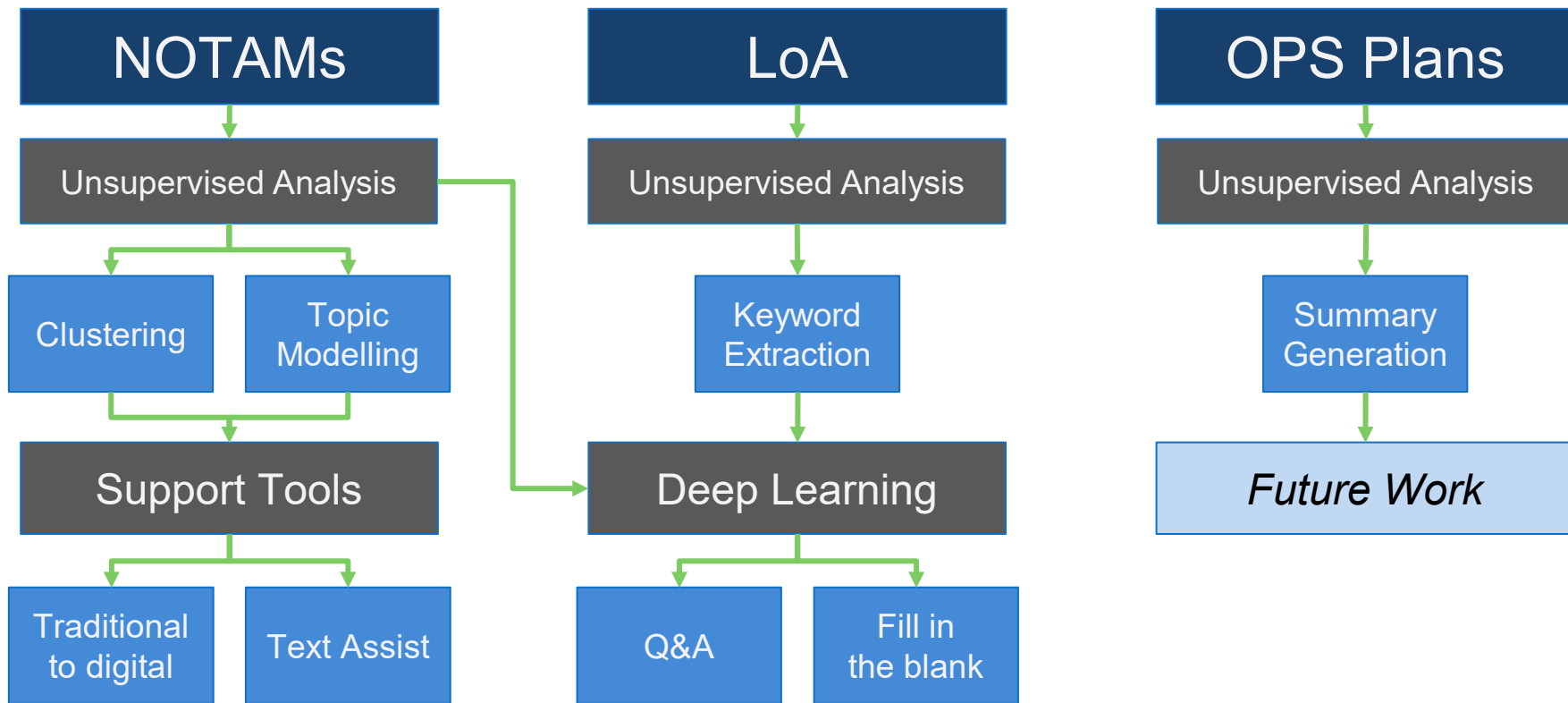
Code: A

Summer 2021

Agenda

- Notice To Airmen (NOTAM)
- Letters of Agreement (LoA)
- Operations Plan Advisories
- FlyMe

Overview



Notice to Airmen

!SFO 04/103 SFO RWY 10L/28R CLSD 2104261400-2108141400

Definition: *Short string of text that represents a restriction or anomalous condition within the National Airspace System (NAS)*

- *Traditional NOTAMs* were adopted into the NAS in 1947
- *Digital NOTAMs* were introduced in 2011, adopted shortly thereafter
 - Capture features and business rules of NOTAMs into XML formatting
- Our dataset contains
 - 3.7 Million NOTAMs between March 2018 and March 2019 (~70% digital)

Notice to Airmen: Unsupervised Analysis

NOTAM Data

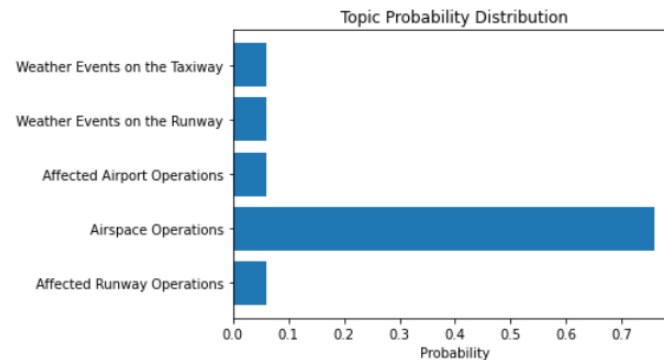
Embedding and Clustering

K-means Clustering of FDC NOTAMs



Topic Modelling

Test NOTAM: !SUAE 02/055 ZTL AIRSPACE SNOWBIRD MOA ACT 11000FT UP TO BUT NOT INCLUDING FL180 1902011700-1902011800



Notice to Airmen - Support Tools

NOTAM Data

Digital NOTAM
Translation

Entity Extraction

SFO RWY 10L/28R CLSD

Airport

Designator

Keyword

Condition

Text Assist

Advanced Search,
Decision Support

SFO RWY 10R/28L |

SFO RWY 10R/28L CLSD

SFO RWY 10R/28L AND

SFO RWY 10R/28L WIP

SFO RWY 10R/28L NOT

Notice to Airmen – Deep Learning and More Info

- "Natural Language Processing (NLP) Techniques for Air Traffic Management Planning," AIAA 2021-2322. AIAA AVIATION 2021 FORUM. August 2021.
 - Patrick Maynard
 - Stephen S. Clarke
 - Jacqueline A. Almache
 - Satvik G. Kumar
 - Swetha Rajkumar
 - Alexandra C. Kemp
 - Rajesh Pai
- Presentation: August 2nd at 1:00PM EST in the ATM-02 Session

Natural Language Processing Analysis of Notices To Airmen for Air Traffic Management Optimization

Stephen S. B. Clarke* and Patrick Maynard[†]
Sacred Heart University, Fairfield, CT, 06825
Harvard University, Cambridge, MA, 02138

Jacqueline A. Almache[‡]
North Carolina State University, Raleigh, NC, 27695

Satvik G. Kumar[§]
Georgia Institute of Technology, Atlanta, GA, 30332

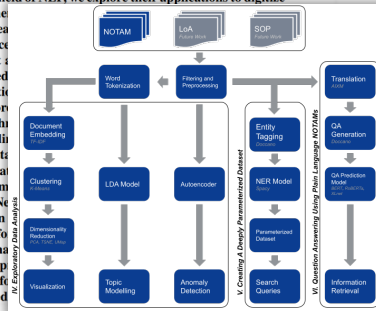
Swetha Rajkumar[¶]
Lynbrook High School, San Jose, CA, 95129

Alexandra C. Kemp^{||}
Purdue University, West Lafayette, IN, 47906

Raj Pai**
National Aeronautics and Space Administration, Mountain View, CA, 94035

With new emerging technologies in the field of NLP, we explore their applications to digitize

and analyze heritage Air Traffic Management airspace operations. Specifically, this research uses advanced data analytics, we will construct language patterns and the use of pretrained models for document classification and document classification. Second, a data-driven approach to generate semi-structured NOTAM format as metadata entities driving NOTAM content. Third, models such as BERT, RoBERTa, and XLNet to perform more robust approach to information tasks. In this work we include various performance metrics to evaluate both accuracy and precision and show the results. The research work developed shows the benefits of the NAS and also offers a new framework for analyzing legacy NOTAMs, that are yet to be digitized.



Letters of Agreement

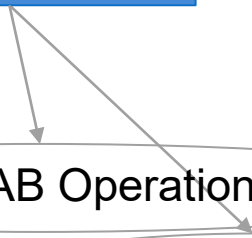
- Letters of Agreement (LoAs) are longer documents outlining the procedures and restrictions for aircraft operations
- Our dataset contains a statistically significant sample of LoAs from different Air Route Traffic Control Centers (ARTCC).

(Name) Air Route Traffic Control Center and (Name) Air Division
LETTER OF AGREEMENT
EFFECTIVE: _____
SUBJECT: Interfacility Coordination for the Control of Aerospace Defense Command Interceptor Aircraft
1. PURPOSE: (List responsibility and describe necessary coordination.)
2. CANCELLATION: (As required.)
3. SCOPE: (Specify area, names, and types of facilities involved.)
4. RESPONSIBILITIES: (Specify.)
5. PROCEDURES:
a. ATC Assigned Airspace. (List procedures to be followed for requesting and authorizing airspace, handling aircraft to and from the airspace, and notifying when no longer required.)
b. Transfer of Control. (Specify transfer procedures.)
c. Departure. (Specify required advanced time for filing flight plans. Outline additional items required in the flight plan; e.g., type of departure, CONAD control facility, and IND position number.)
d. En Route. (including information that ATC is responsible for effecting separation in assigned airspace whenever nonparticipating aircraft are cleared to operate within such airspace.)
e. Arrivals. (Outline handoff procedures and special instructions.)
f. General. (Self-explanatory.)
6. ATTACHMENTS (List, as required, items such as chart of ATC-assigned airspace areas, common reference/handoff points, etc.)
_____ Air Traffic Manager, (Name) ARTCC
_____ Commander, (Name) Air Division
_____ (Title of other appropriate authority)

Letter of Agreement Methodology

LoA Documents

Automatic
Keyword
Extraction



P50 must advise ZAB Operations Manager In Charge (OMIC) at least 30 minutes prior to opening/closing times of the Special Events Sector.

Deep Learning

...establishes and describes operational procedures for...

...establishes and describes operational <MASK> for...

Fill-in-the-blank Using Deep Learning

procedures

Operations Plan Advisories

- Air Traffic Control System Command Center (ATCSCC) Operations Plan
- Discussions on Traffic Management Initiatives (TMI) during unexpected events/operations
- **Goal:** Use AI/ML to generate summaries
- **Purpose:** Make generating summaries easier

ATCSCC ADVZY 157 DCC 08/14/2018 OPERATIONS PLAN

EVENT TIME: 14/2000 - AND LATER

OPERATIONAL GOALS FOR 8/14/18

- MANAGE EWR/LGA/JFK/PHL/TEB AIRPORT OPERATIONS TO KEEP DEPARTURE DELAYS TO LESS THAN 75 MINUTES AND AIRBORNE HOLDING TO LESS THAN 30 MINUTES.

- MANAGE DCA/IAD/BWI AIRPORT OPERATIONS TO KEEP DEPARTURE DELAYS TO LESS THAN 75 MINUTES AND AIRBORNE HOLDING TO LESS THAN 30 MINUTES.

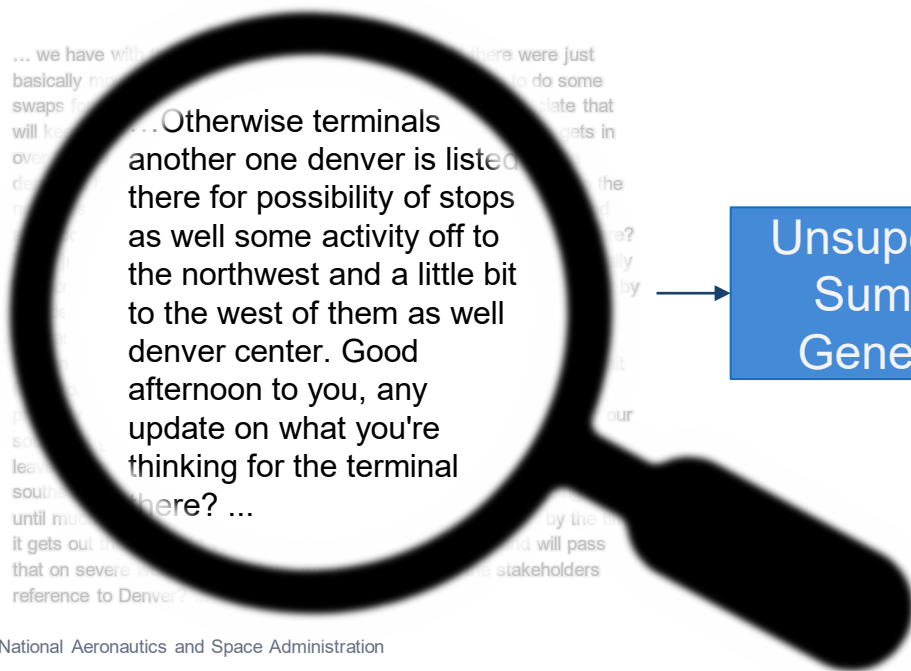
SFO PROGRAM TO REVISE COMING OUT OF GROUND STOP EXPECT CONFERENCE SHORTLY. WEATHER CONDITIONS AT EWR DETERIORATING. LGA PROGRAM SET AT REDUCED AIRBORNE RATE TO PROTECT SURFACE DUE TO DEPARTURE BACKLOGS FROM LACK OF DEPARTURE ROUTES.

TERMINAL ACTIVE:

UNTIL 2159	-SFO GROUND DELAY PROGRAM
UNTIL 0059	-PHL GROUND DELAY PROGRAM
UNTIL 0459	-BOS GROUND DELAY PROGRAM
UNTIL 0559	-LGA GROUND DELAY PROGRAM
UNTIL 0759	-EWR GROUND DELAY PROGRAM
UNTIL 0459	-JFK GROUND DELAY PROGRAM

Operations Plan Summaries Methodology

Transcription Data



Unsupervised
Summary
Generation

Alright I appreciate that will keep the references for a [possibility of stop](#) in case something gets in over the field there moving forward otherwise terminals another one [Denver](#) is listed

Questions?

