Expanding the Capabilities of the NAS Through AI: A Whitebox for the Aerospace Ecosystem

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What Makes a Whitebox?

- **Enhanced Data Management:** The Whitebox concept aligns with advanced data transfer techniques. Data is centralized, easily accessible, and queryable.
- **Novel Data Flows:** The system's adaptability and modularity allows it to process novel data flows and add them to the centralized management system.
- **Real-Time Analysis Potential:** Future ML solutions will involve real-time processing of large amounts of data, consolidating it in one ontology.

System Overview

- **Graph creation** through automatic analysis of data streams
- **Graph output** can be analyzed and feed into future ML models

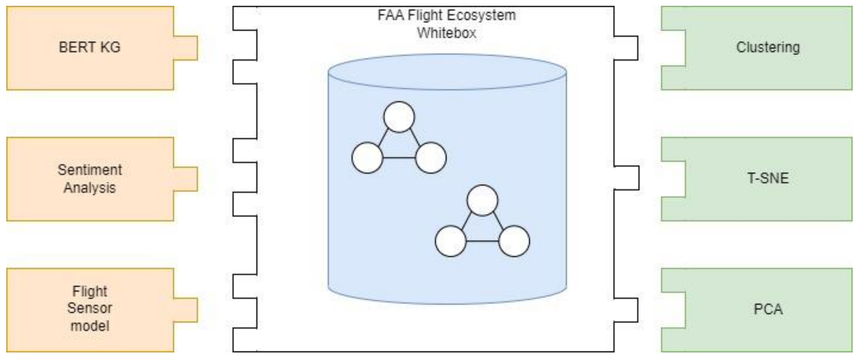


Figure 1. depicts the formation and use of data from the system

Data Management

Ontology

- Provide structure to data relations
- Can easily be updated to accommodate new data

Knowledge Graphs

- Represent data and semantic relationships
- Inherent clustering and analysis capabilities

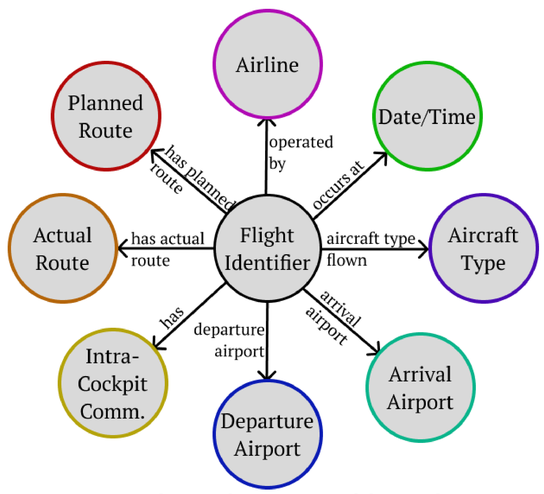


Figure 2. depicts the structure of the ontology used to form the knowledge graph

Novel Data Inputs

- New data is being created by AI tools
  - Text-to Speech
  - Sentiment Analysis

Sentiment Analysis

- Example plug-in ML model
- Analyzing cockpit communication
- Improved accuracy of safety reports
- Recognizing stress and overwork to avoid poor decision-making

Knowledge Querying

Viewing data by:

Flight→ details surrounding a specific flight

Attribute→ extracting data from flights across the database for analysis purposes

Data Outputs

- Advanced querying and knowledge graph analysis are the backbone to future data analysis

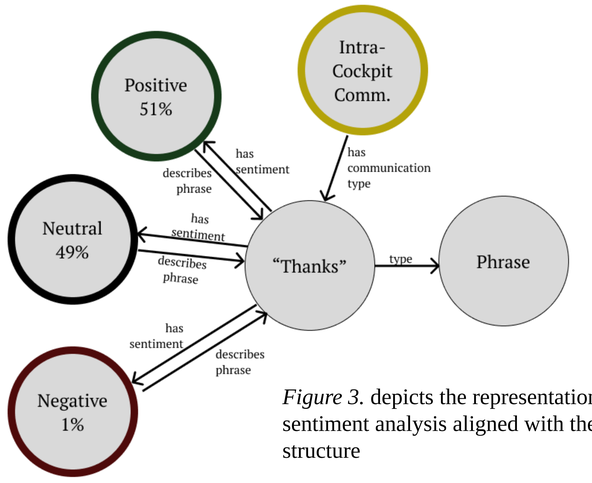
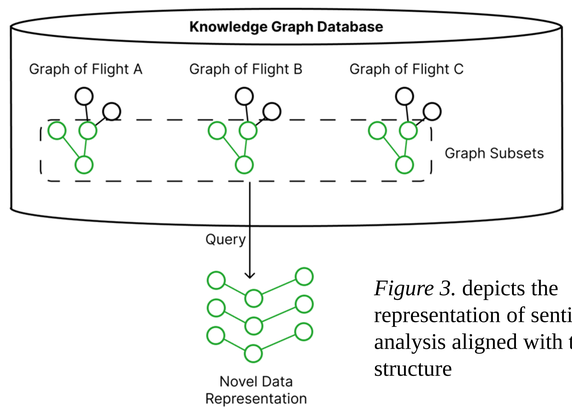


Figure 3. depicts the representation of sentiment analysis aligned with the graph structure



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Future Impact

- Collect data analytics
  - Trends over thousands of flights
  - Analysis techniques used for more perspective
- Construct specific datasets to train specialized ML / DL models
  - Adapting to evolving uses of the NAS
  - Improving aviation safety
  - Improving operational efficiency of the NAS

Alignment with the NAS

- Can aid Trajectory Based Operations (TBO)
- Consolidates existing data
- Utilized alongside SWIM
- ATC/AOC participation