

# Multi-Orbit Interference

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# Overview & Background

**Space ISAC analysts monitor satellite interference worldwide, and our project enhances this effort by developing a web-based tool that organizes open-source data into actionable insights. We created an interactive heatmap to visualize interference events and distinguish between benign and malicious activity. By automating data collection and classification, our tool helps analysts quickly understand the nature, location, and threat level of interference, improving response times and supporting decision-making in the space community.**

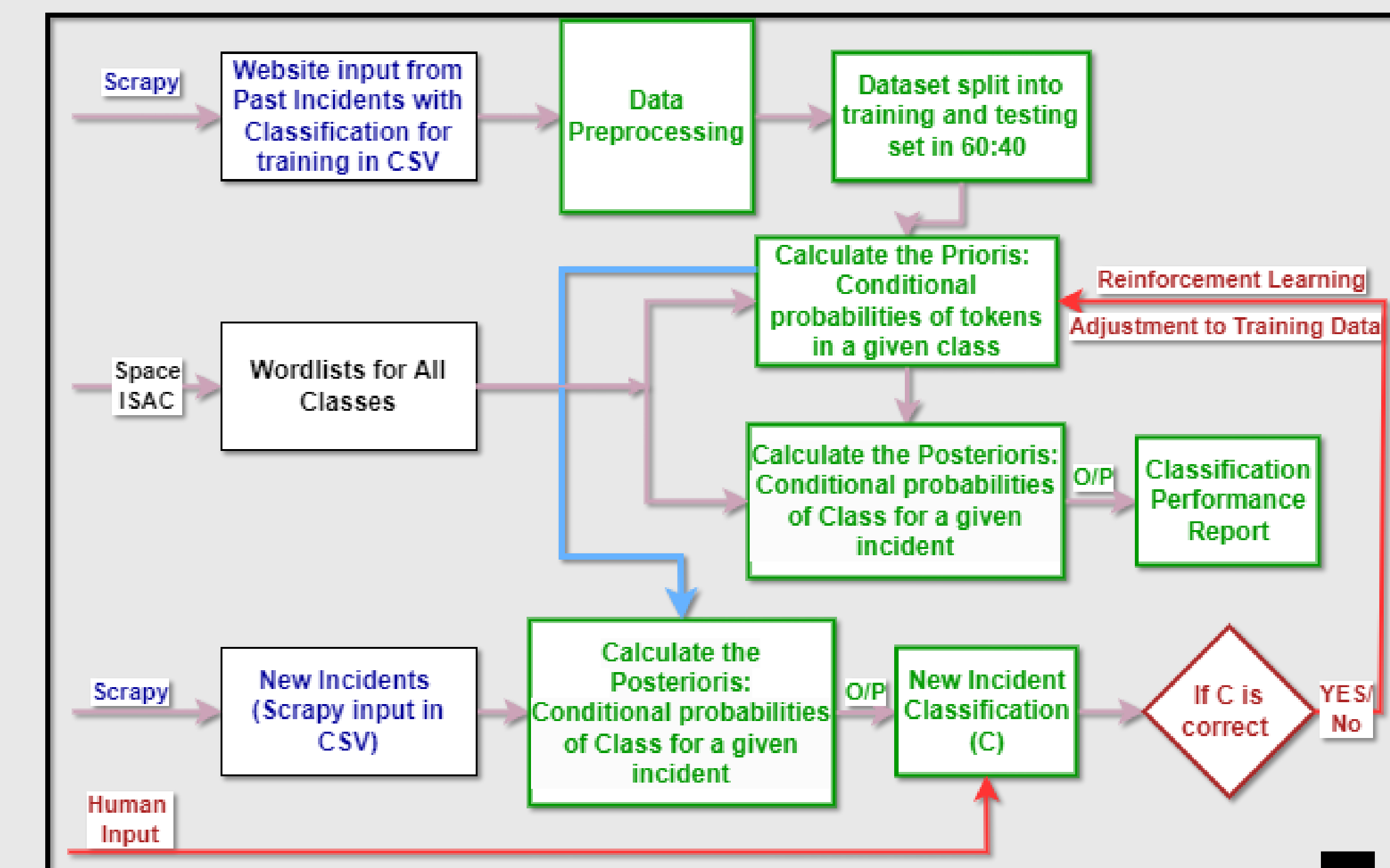
## Work Summary:

## Web Scraping:

- Using a list of websites and keywords from ISAC, we built a Scrapy-based web scraper to search for specific terms.
- The scraper extracted occurrences of each keyword from the webpages, counting appearances and identifying sources.
- The collected data was compiled into a CSV file, with each row containing the keyword, its frequency, and the webpage on which it appeared.

## NLP Classification:

- The classification is designed in two stages: Binary and Multi-Class-Multi-label for TTPs based on SPARTA [1] and/or MITRE ATT&CK [2] frameworks
- Implementation of binary classification using Naïve Bayes Algorithm
- Training Dataset generation using available incident report websites and classification
- Classifier Performance Evaluation: Accuracy 98%
- Testing of Binary Classifier module using the available incident report data as training examples and new article as prediction examples
- Reinforcement Learning: update the training set to add the predicted example after the corrections received from human input
- Multi-Class-Multi-label Classifier prototype design using Support Vector Machine (SVM) Algorithm



## Open AI

- Start with the list of URLs taken from the web scraping team's keyword search
- Use Open AI model as our generative AI to parse the article and extract data (Date, Location, and Summary)
- This data helps the Space ISAC team determine if a given event is worth studying

## Text Prompt Engrg

- Main component of the project
- Used for the keywords: country/location, date and description of the article

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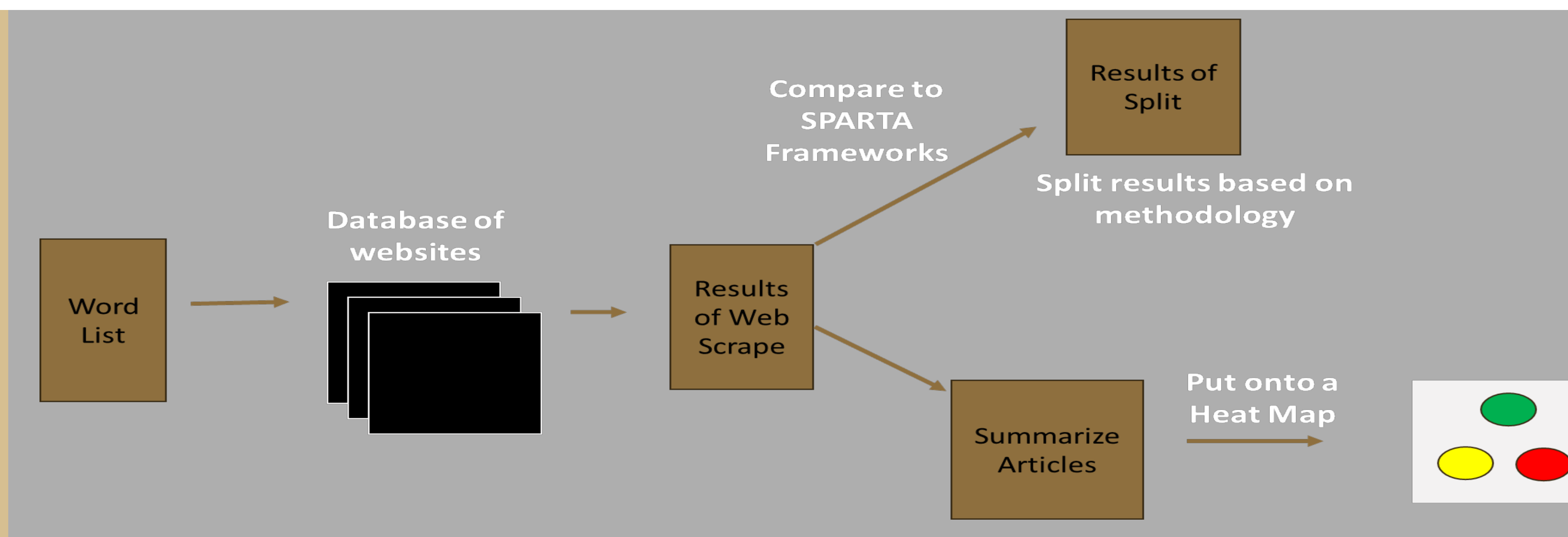
**Core Details:**

* **Countries Involved:** China, United States (for satellite orbit cataloging).
* **Location:** Taiyuan Satellite Launch Center, China (Approximate coordinates needed, not provided in text).
* **Date and Time of Event:** November 13, 2024, at 2242 UTC (5:42 PM Eastern). This event occurred approximately [Calculate time difference from current time] ago.
* **Additional Details:**
    * Date: November 13, 2024
    * Location: China
    * Type: Satellite Launch (Oceanography)

**Heat Mapping Data:**

* **Occurrence 1:**
    * Date: November 13, 2024
    * Location: Taiyuan Satellite Launch Center, China (Longitude/Latitude needed)
    * Type: Satellite Launch
    * Summary: Successful launch of Haiyang-4 oceanography satellite.

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## Heat Map:

- Compile data and plot on a map
- Graphical Python Libs: Folium
- Data Python Libs: countryinfo, numpy, pandas

## Flask app:

- The Flask app hosts the website that combines and schedules parts
- First run the web scraping that generates a PDF/HTML/CSV

## NLP to Heatmap:

- The MITRE ATT&CK classification of the event
- Heat map is then passed the NLP output to determine if an event is a natural or a malicious occurrence



### Work Cited:

- [1] <https://sparta.aerospace.org/>  
[2] <https://attack.mitre.org/>  
[3] Willbold, Johannes, et al. "Space odyssey: An experimental software security analysis of satellites." 2023 IEEE Symposium on Security and Privacy (SP). IEEE, 2023.

### Future improvements:

- Flask could use an update to the UI and add a login/ password feature once it is hosted so only authorized users can access the heatmap
- NLP Classifier Module: Multiclass-multilabel classification using SVM for
  - TTPs classification based on SPARTA and/or MITRE ATT&CK Framework
  - Dataset Generation to increase prediction accuracy of new incidents
- Heat mapping Module: To visualize the locations of malicious causes
- Summarization Module: To generate a human-like text summarization given these inputs with all relevant information needed

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## Data Mine

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# Data Mine of the Rockies Spring 2025