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DAEN 690

Project Report

Fraol Abebe

Kevin Cheng

Matthew Lomicka

Radha Kanuri

Summer 2023

Model for Calibration of Weather Data for Contrail Avoidance

**About the Cover**

Dr. Lance Sherry is an associate professor in the Systems Engineering and Operations Research Department and serves as director of the Center for Air Transportation Systems Research (CATSR) at the College of Engineering and Computing at George Mason University. The CATSR mission is to foster excellence in education and research in Air Transportation System Engineering.

Sherry has pioneered research in data analytics and stochastic simulation of large complex adaptive systems such as the air transportation system, operations of airports, airlines, and air traffic control, as well other network-of-network systems. These analyses are used widely for strategic planning, business development, cost/benefit analysis, and system productivity improvement. He has also conducted award-winning work in human-computer interaction, operator training, and the design of autonomous and semi-autonomous systems (such as Unmanned Air Vehicles).

Sherry has more than 30 years of experience in the aviation industry serving as a flight test engineer, flight control engineer, system engineer, lead system architect, program manager, strategic planner, and business development. He served as a fellow at RAND Corporation from 1999-2001. He has published over 100 papers and journal articles, holds several patents, and has received awards for his work. Sherry is a graduate of Brown University with a BS in electrical engineering, and he holds both an MS and a PhD in industrial and systems engineering from Arizona State University.

Working through CATSR, Dr. Sherry has been a long-time and prolific project partner with the Data Analytics Engineering (DAEN) program offering up some of the most interesting and challenging data analytics engineering capstone projects for DAEN program students including the most recent projects concerning “Navigation Avoidance” of contrails, data gathering and analysis of aerial firefighting methods and effectiveness, and Human Machine Interface (HMI) characteristics of Standard Operating Procedures.

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Abstract

Abstract

**INSTRUCTIONS**

[NOTE: The project abstract is a separately graded assignment in the course. The final approved project abstract is to be copied word-for-word from the other assignment into this report.]

Write one paragraph of no more than 300 words that summarizes your project. Here are the typical kinds of information found in most abstracts which you should use as an outline as you develop your abstract.

1. The context or background information for your research; the general topic under study; the specific topic of your research.
2. The central questions or statement of the problem your research addresses.
3. What’s already known about this question, what previous research was conducted or shown.
4. The main reason(s), the exigency, the rationale, the goals for your research — why is it important to address these questions? Are you, for example, examining a new topic? Why is that topic worth examining? Are you filling a gap in previous research? Applying new methods to take a fresh look at existing ideas or data? Resolving a dispute within the literature in your field?
5. Your research and/or analytical methods.
6. Your main findings, results, or arguments.
7. The significance or implications of your findings or arguments.

Your abstract should be intelligible on its own, without a reader’s having to read your entire paper.

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Report

# Problem Definition

## Background

**REPORT SECTION INSTRUCTIONS**

This section provides 4-5 pages of content for the reader with enough background information about the problem context that allows the paper to be standalone. In other words, assume the reader does not have a background for your project problem and you provide enough content in this section so the reader at a minimum can understand the problem space that you are going to discuss later. Terminology is important and guiding. For example, attempt to minimize the domain vocabulary and when introducing new terms make sure at a minimum, they are defined in Appendix A: Glossary.

Utilize figures, pictures, and tables since visualization are processed faster by the mind.

All references throughout the report follow the IEEE Citation Style.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

An increase in average global temperatures of 1.5° Celsius or 2.7° Fahrenheit is considered the “Point of No Return”, according to the United Nations. The tipping point was agreed upon during the Paris Climate Accord in 2015. In order to prevent the world from reaching the tipping point, countries and organizations need to reduce emitting or contributing to greenhouse gases. One of the larger producers of greenhouse gases is airlines; specifically, through their creation of aircraft induced clouds (AIC). Reducing the formation of AIC is an immediate action that society can make to prevent us from reaching the tipping point.

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## Problem Space

**REPORT SECTION INSTRUCTIONS**

This section describes the specific problem that you will attempt to solve completely or part of the problem. Note well that most project scope their solutions to a part of the problem space. Poor project teams usually fail to understand the problem and our eager to start implementing a solution to what they think is the problem. Most problems a very large and understanding the size of the problem mitigates the risk of foolhardy attempts that usually fail. This section should be about 2 pages and should show that the team understands the breadth and dept of the problem space.

Even with a well-defined sponsored project that may be scoped it is critical to provide the reader with the whole problem space in a concise a terse description, while providing the reader with a map of what part of the problem you are going to solve. This should allow the team to write the project extensions in the section 7 (Future Work). This is actually a lie since the team will discover many new path and areas of the problem space while working on the project.

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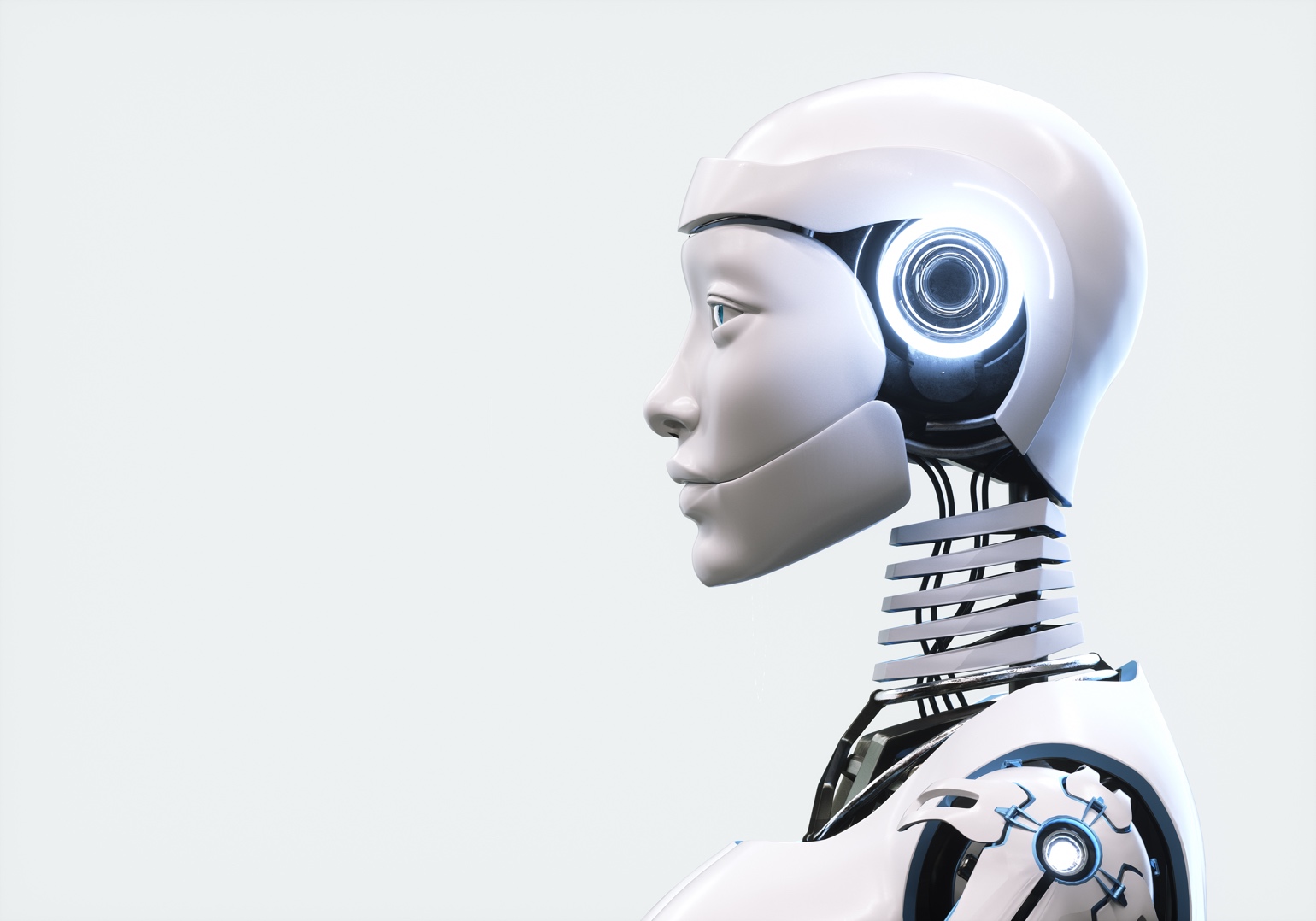


Figure : ChatGPT is the latest Natural Language Processing tool for Data Analytics.

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Figure : Data Analytics Engineering has the power to be transformative for an organization.

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## Research

**REPORT SECTION INSTRUCTIONS**

Document the research the team performed while either developing the solution or attempting to understand a solution path provided by the sponsor. This should be a summary of readings, Internet searches, collaborations, etc. Length of this section can vary but usually around 2-3 pages

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Solution Space

**REPORT SECTION INSTRUCTIONS**

Describe your solution approach. High level and provides your reader with an idea of approach.

Describe the solution space for the reader. For example: “Our system delivers value to its users when it accurately reports veracity scores for submitted articles. Users derive value from these scores when they feel more confident in their chosen news sources or avoid being misled when presented with fake news. We expect our system can help steer users to more authoritative news outlets by altering browsing behaviors.”

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Project Objectives

**REPORT SECTION INSTRUCTIONS**

Answer the following questions regarding the project objectives.

1. What does the team assume it will learn after finishing this project?
2. What does the team assume they will achieve as a solution when they finish this project?
3. What does the team assume it will achieve in terms of understanding about the problem after they finish this project?
4. What does the team assume it will provide in value as a product of this project work to the world, targeted group, etc.?

The above questions about the project objectives can be used to develop the primary user stories in section 1.6.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Primary User Stories

**REPORT SECTION INSTRUCTIONS**

This story or stories explicitly state what the project is attempting to address: For example: Based on the user context and value proposition, we developed the following primary user story to guide our project:

“As a User, I want to submit an article to the Veracity System and receive a veracity score to know how much to trust a particular news article.”

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Product Vision

**REPORT SECTION INSTRUCTIONS**

Describe scenarios for why someone would want to use this solution.

* For:
* Who:
* The:
* Is a:
* That:
* Unlike:
* Our product:
* Caveats:

Provide at least two scenarios below for the project.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

### Scenario #1

### Scenario #2

# Datasets

## Overview

**REPORT SECTION INSTRUCTIONS**

Provide a descriptive overview of your datasets.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Field Descriptions

**REPORT SECTION INSTRUCTIONS**

Described your dataset field. Make sure you study the example below and you will more than likely expand these fields:

1. URL (Type: string) – The web address or Universal Resource Locator for the webpage that contained the news article. This includes the protocol (http or https), host name, and subdomain. Some URLs also include parameters (text following ‘?’) or named anchors (text following a ‘#’). Each URL can only be present once in the database, even if the webpage is not static over time.
2. Title (Type: string) – The title of the news article as parsed by the Newspaper 3K module. This field may be null (~150 articles in our dataset do not have titles).
3. Authors (Type: string) –The authors of the news article as parsed by the Newspaper 3K module. This field may be null (~23,000 articles do not have authors) and articles with multiple authors have their names joined with a comma into a single string. This field may also pick up descriptions of the author, including their titles and background.
4. Publication Date (Type: datetime) – The article publication date and time as parsed by the Newspaper 3K module. The datetime is displayed in ISO 8601 format (YYYY-MM-DD Thh:mm:ss+offset). Publish dates without specified times are assumed to be published at midnight. Publication dates with time information, but without a time zone listing, are assumed to be in Eastern Standard Time. This field is not allowed to be null.
5. Text (Type: string) – The text of an article as parsed by Newspaper 3K. This field may be null (~8,000 articles do not have text) as some news stories are delivered as only video, audio, or a picture. The mean word count for text is 538.9 across all news sources.
6. Tags (Type: string) – Article tags as determined by Newspaper 3K. These appear to be important (rare or “topicy”) words taken from the article text, not meta tags contained in the article’s HTML. Multiple tags are concatenated with a comma into a single string.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Data Context

**REPORT SECTION INSTRUCTIONS**

Provide a description of the data context.

Data context is the set of circumstances that surround a collection of data. Capturing and interpreting context is a basic step in data analysis. Use of out-of-context data is a common source of errors in scientific research, business decisions, and professional advice.

In business analytics (BA), gathering context from external sources can provide useful information about events that have significance for the organization. Context for an unexplained surge in sales, for example, could be provided by pulling in data from news and social media as well as less obvious sources, such as weather over that period. Explored in context, it may be able to identify external causes for the increase, and that information might be used to guide future business decisions.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Data Conditioning

**REPORT SECTION INSTRUCTIONS**

Describe the data conditioning required for each data set.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Data Quality Assessment

**REPORT SECTION INSTRUCTIONS**

At a minimum you must assess your data sets with the following attributes:

* Completeness
* Uniqueness
* Accuracy
* Atomicity
* Conformity
* Overall Quality

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Other Data Sources

**REPORT SECTION INSTRUCTIONS**

If you are considered other data sources, however, you decided not to use these sources provide some reason why they were not utilized.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Storage Medium

**REPORT SECTION INSTRUCTIONS**

Discuss the storage medium selected for the project data set storage.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Storage Security

**REPORT SECTION INSTRUCTIONS**

Discuss the storage security required for the project data set storage.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Storage Costs

**REPORT SECTION INSTRUCTIONS**

Discuss storage costs associated with the storage medium used for the project data set storeage,

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

# Algorithms & Analysis / ML Model Exploration & Selection

## Solution Approach

**REPORT SECTION INSTRUCTIONS**

Provide a detailed discussion of the solution approach. Include discussions on any of the following:

1. Systems Architecture
2. Systems Security
3. Systems Data Flows
4. Algorithms & Analysis
5. Machine Learning (delete this subsection for non-machine learning projects.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

### Systems Architecture

### Systems Security

### Systems Data Flows

### Algorithms & Analysis

## Machine Learning

**REPORT SECTION INSTRUCTIONS**

For Machine Learning projects discuss the model exploration and selection process. Delete this report subsection for non-machine learning projects.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

### Model Exploration

### Model Selection

# Visualizations / ML Model Training, Evaluation, & Validation

## Overview

**REPORT SECTION INSTRUCTIONS**

Provide an overview of what was accomplished during Sprint 4. Focus visualizations for non-machine learning projects.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

## Visualizations

## Machine Learning

**REPORT SECTION INSTRUCTIONS**

For Machine Learning projects, discuss your approach to the following with respect to the ML Model:

1. Training,
2. Evaluation, and
3. Validation of the ML Model.

Delete this report subsection for non-machine learning projects.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

### Model Training

### Model Evaluation

### Model Validation

# Findings

**REPORT SECTION INSTRUCTIONS**

Discuss the major findings of the project.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

# Summary

**REPORT SECTION INSTRUCTIONS**

Summarize the overall project and results for the reader. What did you discover, prove, disprove, etc.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

# Future Work

**REPORT SECTION INSTRUCTIONS**

This is critical section of the report. Propose future follow-on work or next step(s) for the project.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

Appendix

# Appendix A Glossary

|  |  |
| --- | --- |
| Term | Definition |
| Aircraft Induced Clouds (AIC) | Also known as “condensation trails” or “contrails”. These types of artificial clouds are formed by water vapors and particles, byproducts from a jet engine, and are combined at a cold and low-pressure environment. |
| Global Radiative force (RF) | As the Earth absorbs energy from the sun, it must eventually emit an equal amount of energy to space. The difference between incoming and outgoing radiation is known as a planet’s radiative forcing (RF). |
| Ice Super Saturation (ISS) | Under specific atmospheric conditions, known as ice super saturation (ISS), these contrails can grow, spread, and persist for up to 10h. These long lived “ice clouds” are defined by the World Meteorological Organization as cirrus homogenitus or AIC and are the only anthropogenic clouds. |

Table : Glossary Table

**REPORT SECTION INSTRUCTIONS**

Place all terms which require definitions in the Appendix A: Glossary.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

# Appendix B GitHub Repository

Overview

**REPORT SECTION INSTRUCTIONS**

Provide a GitHub Link and the README.MD content. Do not just provide a link to the GitHub repository but provide a narrative paragraph which introduces the project. This section should mirror the look and feel of a well-documented professional GitHub site.

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GitHub Repository Link

[https://github.com/Fraolabebe/Team-SkySci-Analytics](https://nam11.safelinks.protection.outlook.com/?url=https%3A%2F%2Fgithub.com%2FFraolabebe%2FTeam-SkySci-Analytics&data=05%7C01%7Crkanuri%40gmu.edu%7C1003b68804ce4c240b3308db5eedc0ce%7C9e857255df574c47a0c00546460380cb%7C0%7C0%7C638208147470698642%7CUnknown%7CTWFpbGZsb3d8eyJWIjoiMC4wLjAwMDAiLCJQIjoiV2luMzIiLCJBTiI6Ik1haWwiLCJXVCI6Mn0%3D%7C3000%7C%7C%7C&sdata=jiQLvGSI95YNlMVYN3XG0RkkIyU0O%2F7NK5UgNsrb1IY%3D&reserved=0)

GitHub Repository Contents

# Appendix C Risks

Sprint 1 Risks

**REPORT SECTION INSTRUCTIONS**

Include the risk table associated with the Sprint. Below the risk table provide a narrative description of how the risks and mitigation plans were identified, what the team got correct, what the team could have done differently, how accurate was the team in identifying the risks, did the team encounter any unanticipated risks, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Table : Sprint 1 Risks

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Sprint 2 Risks

**REPORT SECTION INSTRUCTIONS**

Include the risk table associated with the Sprint. Below the risk table provide a narrative description of how the risks and mitigation plans were identified, what the team got correct, what the team could have done differently, how accurate was the team in identifying the risks, did the team encounter any unanticipated risks, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Sprint 3 Risks

**REPORT SECTION INSTRUCTIONS**

Include the risk table associated with the Sprint. Below the risk table provide a narrative description of how the risks and mitigation plans were identified, what the team got correct, what the team could have done differently, how accurate was the team in identifying the risks, did the team encounter any unanticipated risks, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Table : Sprint 3 Risks

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Sprint 4 Risks

**REPORT SECTION INSTRUCTIONS**

Include the risk table associated with the Sprint. Below the risk table provide a narrative description of how the risks and mitigation plans were identified, what the team got correct, what the team could have done differently, how accurate was the team in identifying the risks, did the team encounter any unanticipated risks, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Table : Sprint 4 Risks

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Sprint 5 Risks

**REPORT SECTION INSTRUCTIONS**

Include the risk table associated with the Sprint. Below the risk table provide a narrative description of how the risks and mitigation plans were identified, what the team got correct, what the team could have done differently, how accurate was the team in identifying the risks, did the team encounter any unanticipated risks, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Table : Sprint 5 Risks

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# Appendix D Agile Development

Scrum Methodology

**REPORT SECTION INSTRUCTIONS**

Provide a narrative of the team efforts in using a scrum methodology for a data analytics engineering project. Describe how easy/difficult was it to adapt to the Scrum methodology. Did the team conduct a daily scrum? If not, how often did the team conduct a scrum. Describe how easy/difficult it was to use the YouTrack tool to manage the project. Don’t be limited to just these questions. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Figure : Sprint project dates

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Sprint 1 Analysis

**REPORT SECTION INSTRUCTIONS**

Provide a narrative of the team’s efforts during this Sprint. Be sure to include – but not be limited to – how the team identified the User Stories, how well the team performed with the various tasks, how easy/difficult it was for the team to manage their activities during the Sprint, what did the team do correct, what could/should the team have done differently, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

**DELETE THIS TEXT BOX AFTER YOU HAVE READ AND UNDERSTOOD THE INSTRUCTIONS.**

Quis lectus nulla at volutpat diam ut venenatis tellus. Diam sollicitudin tempor id eu nisl nunc mi ipsum. Nisi vitae suscipit tellus mauris a diam maecenas. Habitant morbi tristique senectus et netus et. Cras adipiscing enim eu turpis egestas. Nisl nunc mi ipsum faucibus vitae aliquet. Eu facilisis sed odio morbi quis commodo odio aenean. Est ante in nibh mauris cursus mattis molestie a. Ipsum suspendisse ultrices gravida dictum fusce ut. Adipiscing elit duis tristique sollicitudin nibh sit amet commodo. Laoreet sit amet cursus sit amet dictum.

Sprint 2 Analyis

**REPORT SECTION INSTRUCTIONS**

Provide a narrative of the team’s efforts during this Sprint. Be sure to include – but not be limited to – how the team identified the User Stories, how well the team performed with the various tasks, how easy/difficult it was for the team to manage their activities during the Sprint, what did the team do correct, what could/should the team have done differently, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Sprint 3 Analysis

**INSTRUCTIONS**

Provide a narrative of the team’s efforts during this Sprint. Be sure to include – but not be limited to – how the team identified the User Stories, how well the team performed with the various tasks, how easy/difficult it was for the team to manage their activities during the Sprint, what did the team do correct, what could/should the team have done differently, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Sprint 4 Analysis

**REPORT SECTION INSTRUCTIONS**

Provide a narrative of the team’s efforts during this Sprint. Be sure to include – but not be limited to – how the team identified the User Stories, how well the team performed with the various tasks, how easy/difficult it was for the team to manage their activities during the Sprint, what did the team do correct, what could/should the team have done differently, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Sprint 5 Analysis

**REPORT SECTION INSTRUCTIONS**

Provide a narrative of the team’s efforts during this Sprint. Be sure to include – but not be limited to – how the team identified the User Stories, how well the team performed with the various tasks, how easy/difficult it was for the team to manage their activities during the Sprint, what did the team do correct, what could/should the team have done differently, etc. Think of this writeup as a “lessons learned” that you would like to pass along to any project team thinking of doing a similar project.

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Reference

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