CSE 446: Reinforcement Learning
Spring 2023

Professor: Alina Vereshchaka

FINAL PROJECT REPORT

TEAM MEMBERS

mlarbida@buffalo.edu
joelsolo@buffalo.edu
miheerku@buffalo.edu

Abstract

Flight delays and cancellations are often caused by a complex combination of factors, and weather is undoubtedly one of the most influential factors. In this project we explored the Deep Q-learning model for predicting flight delays based on the real weather data and trained the Gradient boosting classifier.

Introduction

Flight delays and cancellations can lead to significant customer dissatisfaction and economic losses for airlines. Accurately predicting flight delays is crucial for improving operational efficiency and reducing the impact of such disruptions. In this study, we aim to minimize human intervention in flight delay decision-making by focusing on the weather as a key factor. We use Deep Q-Network to train a model that can make significant decisions based on weather features, reducing the decision-making burden on human operators. Our analysis focuses on the performance of the model in predicting flight delays based on the weather, which can provide airlines with valuable insights for improving their operations and minimizing the impact of weather-related disruptions.

Methods

2.1. Data Preprocessing

We used historical weather and flight delays dataset for this task. And did Feature selection of the following columns:

```
weather_features = [
        "PRCP",
        "SNOW",
        "SNWD",
        "TMAX",
        "AWND",
        "LATITUDE",
        "LONGITUDE",
        "DEP_AIRPORT_HIST",
```

```
"DAY_HISTORICAL",
"DEP_DEL15",
```

In order to get the correct model, we cleaned the data by removing all the none values, making sure all the features have the right data type and getting rid of unwanted features. In this Project, we are only focusing on features that are related to the weather conditions.

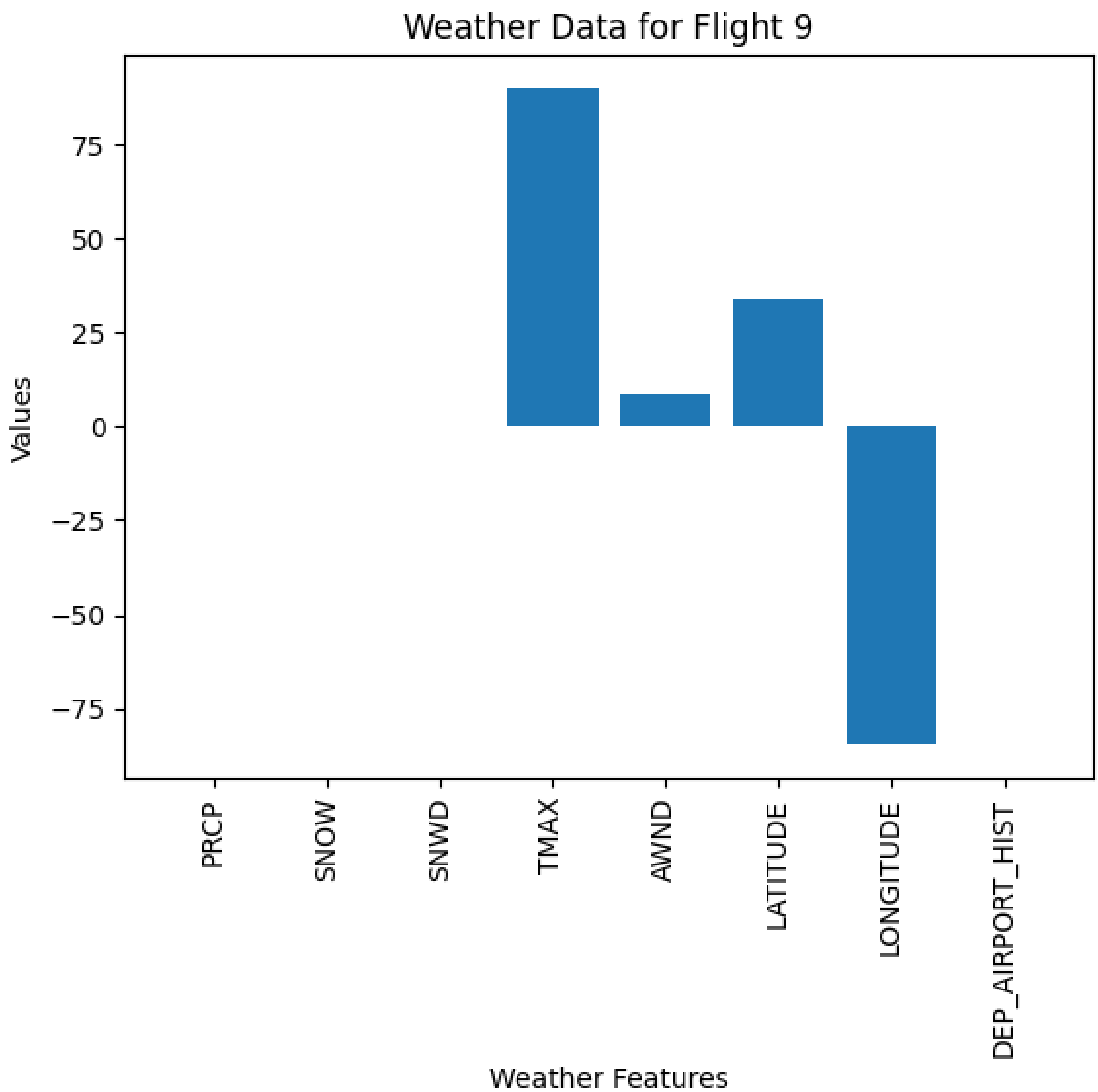

Figure 1: Flight Number 9 X-axis represents values at the time of flight 9.

2.2 Defining the Environment:

We created a custom gym (OpenAI) environment called AirportEnv to simulate the task of predicting flight delays based on the weather conditions. The environment used a pre-trained model Random Forest Classifier to predict delays and calculate the rewards based on predicted values, but also, considering other factors such as Safety of the flight. It also penalizes the agent if there is a safety issue due dangerous weather conditions. Also, there is a render function that displays the current flight data but also presents it as a graph for human readable form.

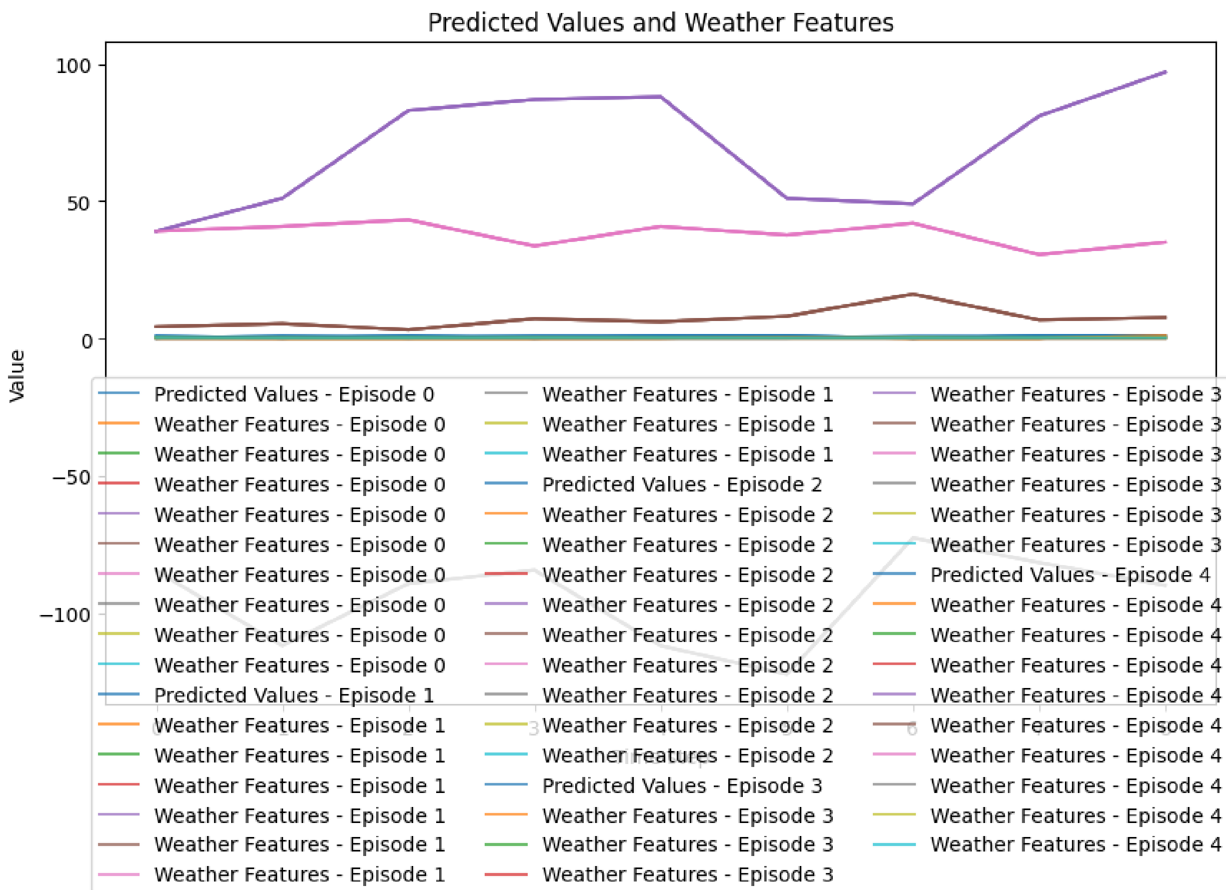

Figure 2: Showed Predicted Values and Weather Features for the first 4 episodes.

2.3 Deep Learning:

We implemented a Deep Q-Learning Algorithm using a deep neural network as a function approximator for the Q-Values. The algorithm learns an optimal policy for predicting flight delays by iteratively updating q-values based on the observed rewards and transitions.

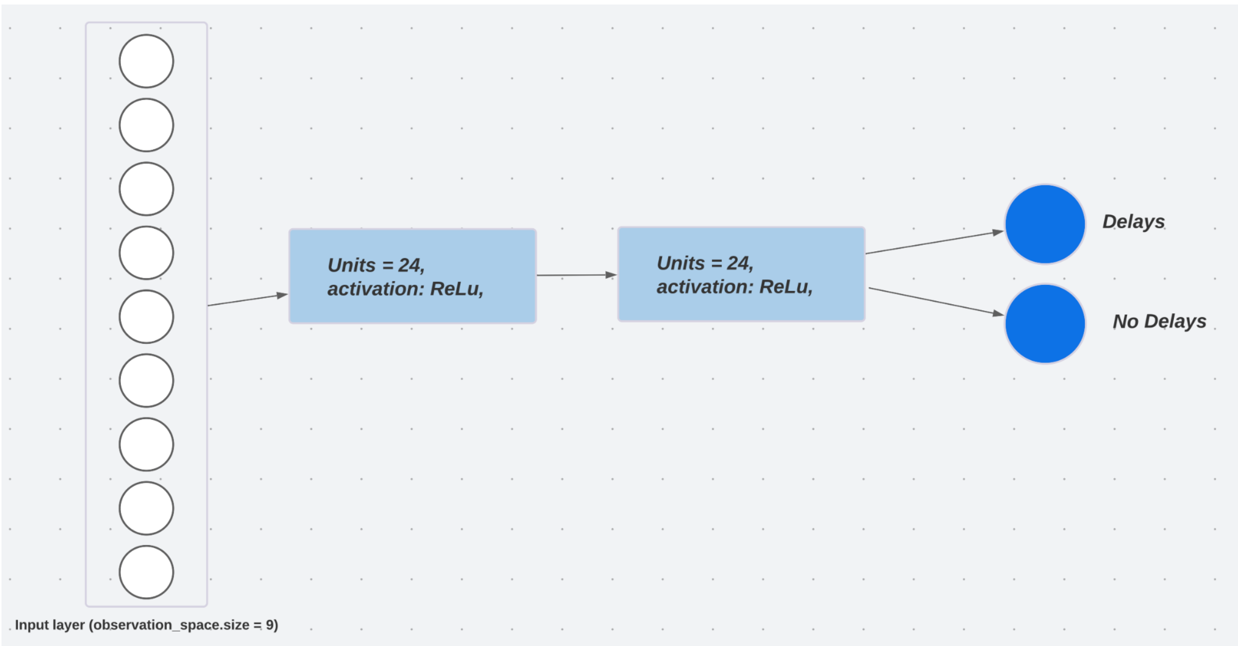

Figure 3: Simple forward Prop Neural Network used in Deep-QLearning

Results

We trained the Deep-QLearning algorithm for a fixed number of episodes (350 episodes) to maximize total_rewards per episode and decay epsilon.

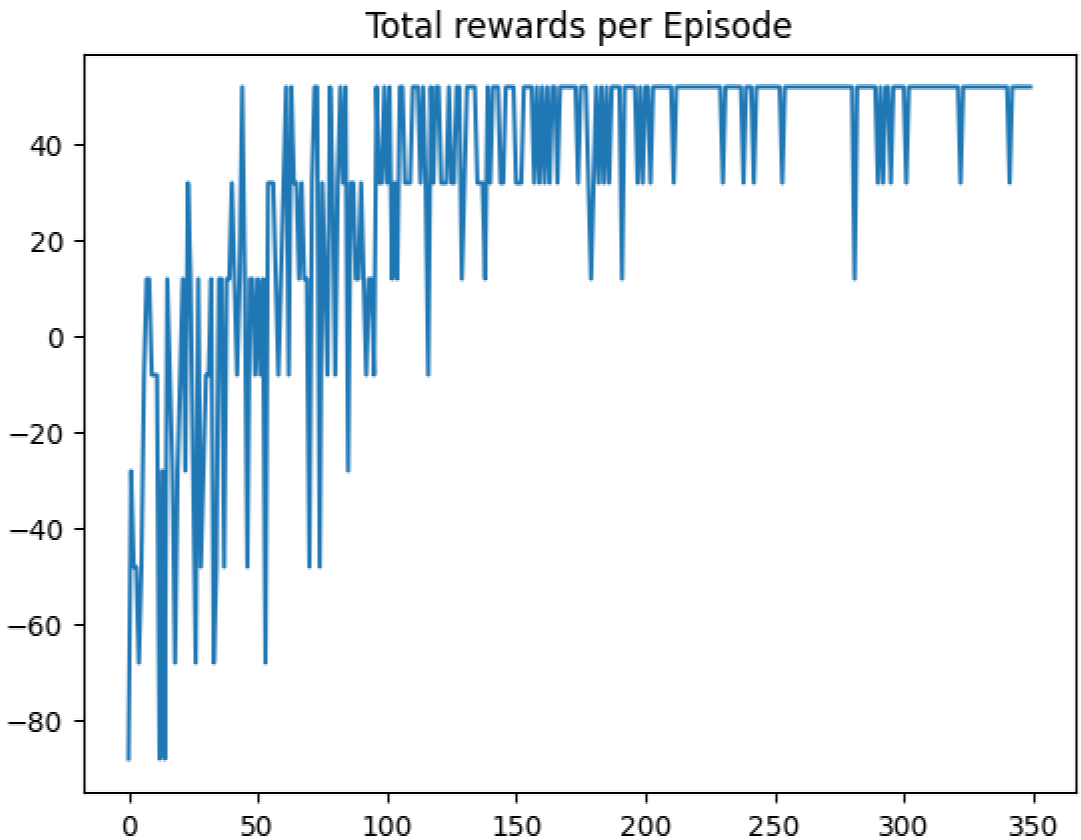

Figure 4: Total rewards per episode

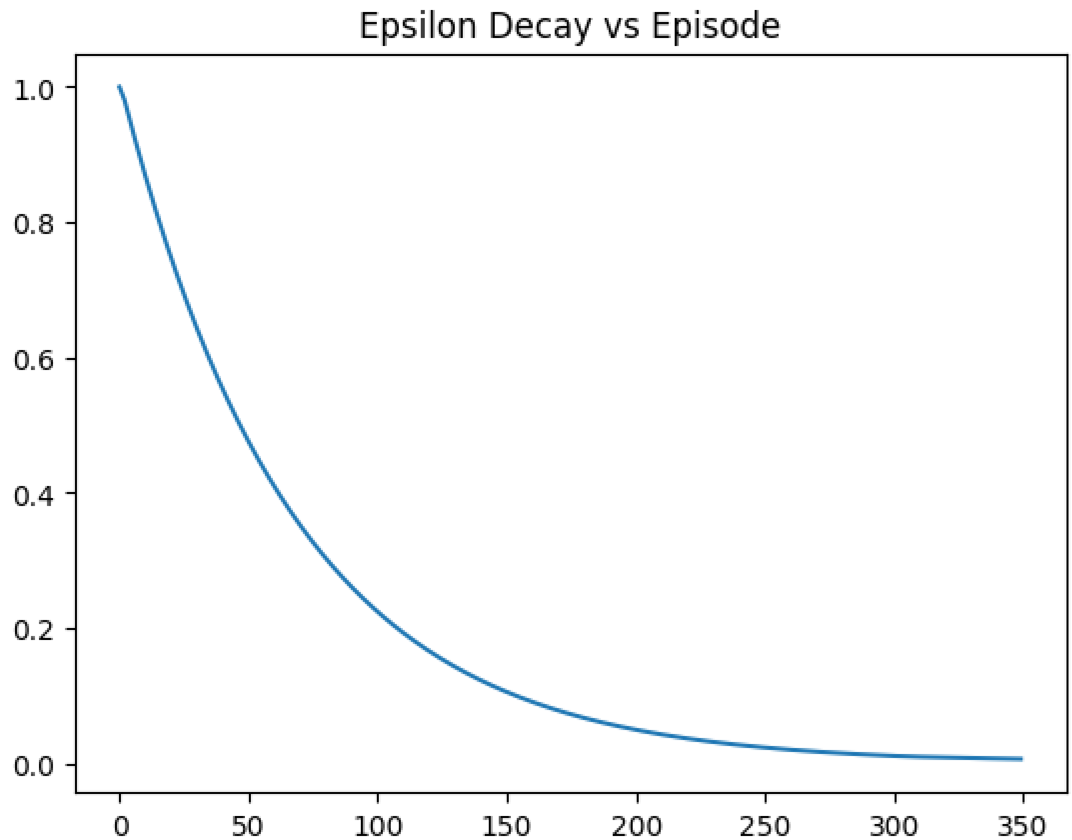

Figure 5: Epsilon Decay per episode

Discussions

In this work, we demonstrated the potential of building reinforcement learning algorithms for predicting flight delays on the weather data. We believe there is much more room for improvement such as implementing highly sophisticated models such as ***Trust Region Policy Optimization.***