

1. Introduction

This is a simple flight search system that take users' inputs including date, origin, destination, cabin class, and number of passengers to search for the corresponding direct flights. The program provides some sorting and advanced filter options. It displays all the search results in a table.

The packages used in this program are tkinter, requests, json, numpy, and copy. Simply run the entire code to start the program.

The link to GitHub is <https://github.com/cnuona/SI-507-Final-Project>.

2. Data Source

The flight API used for this program can be found at <https://rapidapi.com/tipsters/api/priceline-com-provider/>. The data format is JSON.

Users input their flight search requirements on the user interface or the tkinter text entry boxes. The corresponding flight data is retrieved from API with these inputs. I didn't use caching here. I referred the coding format provided in the data's source page to access the data.

The number of data points/observations vary based on the flights that users want to search for. When I designed the program, I used a sample of 40 observations as the testing data.

Each search result is stored in a dictionary-like data structure and contains 20 fields or keys. Only these keys have useful information for this program: *pricedItinerary*, *slice*, *segment*.

Only this information: *flight number*, *departure time*, *arrival time*, *departure airport*, *arrival airport*, *total price*, and *flight duration*, were extracted from the search result data.

Flight number, departure time, arrival time, departure airport, arrival airport, flight duration can be found from the values of the “segment” key. Total price can be found from the values of the “pricedItinerary”.

Because “segment” doesn’t store total price values, I used the uniqueSegId values from “segment” to find the corresponding the “uniqueSliceId” values from “slice”. “uniqueSliceId” was used to locate total prices from “*pricedItinerary*”.

3. Data Structure

After users first input their requirements, the program will extract the necessary information from the search results and save it in a json file (here is when caching was used).

There are two types of data structures this project used to implement its features.

First, for the search result display and sorting, the search result data is stored in a json/dictionary that was cached in the previous step. Each key is flight number and value is flight information, as shown below.

```
for i in search_data.keys():
    print(i, search_data[i])

'AA1872', ('departure time': '2022-06-172010:07:00', 'arrival time': '2022-06-17110:08:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'864219', ('departure time': '2022-06-172010:07:00', 'arrival time': '2022-06-17110:08:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'AA530', ('departure time': '2022-06-172010:07:00', 'arrival time': '2022-06-17110:08:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'864078', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171114:33:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'864375', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171114:35:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 133, 'total price': 197.61)
'864376', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171114:35:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 133, 'total price': 197.61)
'864377', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171114:34:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 134, 'total price': 172.61)
'UAI557', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172114:14:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 137, 'total price': 172.61)
'AA532', ('departure time': '2022-06-171113:38:00', 'arrival time': '2022-06-172234:55:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 137, 'total price': 197.61)
'AA5320', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172234:45:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 137, 'total price': 197.61)
'864360', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172234:45:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 137, 'total price': 197.61)
'864361', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172234:45:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 137, 'total price': 197.61)
'AA2371', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172233:00:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'864094', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172233:00:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'864229', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172233:00:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'864316', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171116:35:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 125, 'total price': 172.61)
'AA5321', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:00:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'AA5322', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:00:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'UAI982', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172010:09:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 129, 'total price': 172.61)
'AA5357', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172233:34:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 124, 'total price': 172.61)
'UAI120', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172233:34:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 124, 'total price': 172.61)
'UAI174', ('departure time': '2022-06-172010:09:00', 'arrival time': '2022-06-172233:42:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 140, 'total price': 172.61)
'864123', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:40:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 130, 'total price': 172.61)
'864253', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:40:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'AA5351', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:40:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'DLS51', ('departure time': '2022-06-171105:05:00', 'arrival time': '2022-06-172113:21:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 136, 'total price': 176.61)
'AA7474', ('departure time': '2022-06-171105:05:00', 'arrival time': '2022-06-172113:29:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 136, 'total price': 176.61)
'AA5352', ('departure time': '2022-06-171105:05:00', 'arrival time': '2022-06-172211:30:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'AA5353', ('departure time': '2022-06-171105:05:00', 'arrival time': '2022-06-172211:30:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'AA5381', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171116:34:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 124, 'total price': 172.61)
'AA5318', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:34:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 145, 'total price': 172.61)
'AA5354', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:34:00', 'departure airport': 'ORD', 'arrival airport': 'JFK', 'flight durations': 145, 'total price': 172.61)
'AA5361', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171113:31:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'864158', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172020:33:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 123, 'total price': 172.61)
'864143', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171911:11:00', 'departure airport': 'ORD', 'arrival airport': 'EWA', 'flight durations': 121, 'total price': 197.61)
'AA5370', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:22:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 125, 'total price': 172.61)
'AA5370', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-172211:30:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 125, 'total price': 172.61)
'864023', ('departure time': '2022-06-171213:30:00', 'arrival time': '2022-06-171513:34:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 124, 'total price': 172.61)
'864209', ('departure time': '2022-06-171213:30:00', 'arrival time': '2022-06-171513:34:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 124, 'total price': 172.61)
'864241', ('departure time': '2022-06-171213:30:00', 'arrival time': '2022-06-171714:35:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 125, 'total price': 172.61)
'AA5337', ('departure time': '2022-06-171707:30:00', 'arrival time': '2022-06-172110:34:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 124, 'total price': 172.61)
'AA5302', ('departure time': '2022-06-171113:30:00', 'arrival time': '2022-06-171616:35:00', 'departure airport': 'ORD', 'arrival airport': 'LGA', 'flight durations': 125, 'total price': 172.61)
```

Second, a tree was used to store flight data for the advanced filter feature of this program. The class for tree node was referred from <https://www.geeksforgeeks.org/generic-tree-level-order-traversal/>, as shown below.

```
...
#####
# The code below was referred from
# https://www.geeksforgeeks.org/generic-tree-level-order-traversal/
...

class Node:
    def __init__(self, key):
        self.key = key
        self.child = []
    def newNode(key):
        temp = Node(key)
        return temp
...
#####
...
```

Each node object has instance values of key and children nodes. For this tree, every internal node is a criterion that divides flights into different groups and leaf node is connected with the assigned flights that meet all the previous criteria. In other words, each internal node is connected with another internal node, and each leaf node is connected with a list of flights that satisfy the conditions given by the previous internal nodes. Then the program traverses through the tree (for example, go to left, middle, or right children nodes), based on how users want to filter (for example, only show morning flights whose prices are lower than average).

4. Interaction

The video demo can be found

<https://drive.google.com/drive/folders/1YWpWdKT5tEK4fuTK8lGJTQux0pTYhrBo>.

Below is a sample search window. Users are required to input departure date, origin, destination, class, and number of passengers. Departure date should be input in the format shown below. Due to the limited of time for this project, the program can only take city abbreviations for origin and destinations. Also, users have options to sort search results

by arrival time, departure time, total price, or flight duration, in an ascending or descending order. This sorting is not required to initiate a search.

The screenshot shows the "Flight Search System" interface. At the top, there are input fields for "Departure Date" (2022-06-17), "Origin" (CHI), "Destination" (NYC), "Class" (Premium Economy), "Number of Passenger" (1), and "Optional: sort by" (arrival time, from low to high). Below these are buttons for "Search Flights" and "Advanced Filter".

After search query is initiated, users can scroll up or down to view search results. They can also filter flights based on departure times and prices.

Here is the sample from the advanced filter.

The screenshot shows the search results table with an advanced filter applied. The filter includes "Below the average price" and "Afternoon flights (depart between 12pm - 6pm)". The results show flights from CHI ORD to NYC EWR, LGA, or JFK on June 17, 2022, with flight durations ranging from 129 to 140 minutes and total prices from USD228.6 to USD428.59.

Flight Number	Departure Date and Time	Arrival Date and Time	Departure Airport	Arrival Airport	Flight Duration	Total Price/person
UA1774	2022-06-17 21:29:00	2022-06-18 00:42:00	CHI ORD	NYC EWR	140 minutes	USD428.59
UA1982	2022-06-17 06:00:00	2022-06-17 09:09:00	CHI ORD	NYC LGA	129 minutes	USD228.6
UA661	2022-06-17 06:00:00	2022-06-17 09:13:00	CHI ORD	NYC EWR	133 minutes	USD288.6
DL551	2022-06-17 06:05:00	2022-06-17 09:21:00	CHI ORD	NYC LGA	136 minutes	USD216.6
UA1657	2022-06-17 07:00:00	2022-06-17 10:14:00	CHI ORD	NYC LGA	134 minutes	USD232.6
DL2550	2022-06-17 07:00:00	2022-06-17 10:23:00	CHI ORD	NYC LGA	138 minutes	USD248.6
UA209	2022-06-17 07:15:00	2022-06-17 10:30:00	CHI ORD	NYC LGA	138 minutes	USD248.6
UA2164	2022-06-17 07:32:00	2022-06-17 10:47:00	CHI ORD	NYC EWR	135 minutes	USD318.6
UA1932	2022-06-17 08:00:00	2022-06-17 11:19:00	CHI ORD	NYC LGA	139 minutes	USD288.6
DL556	2022-06-17 08:30:00	2022-06-17 11:48:00	CHI ORD	NYC LGA	138 minutes	USD248.6
UA2204	2022-06-17 09:00:00	2022-06-17 12:09:00	CHI ORD	NYC LGA	129 minutes	USD18.6
UA1930	2022-06-17 09:00:00	2022-06-17 12:23:00	CHI ORD	NYC EWR	135 minutes	USD428.59
DL1098	2022-06-17 09:15:00	2022-06-17 12:38:00	CHI ORD	NYC LGA	135 minutes	USD18.6
UA1210	2022-06-17 10:41:00	2022-06-17 14:09:00	CHI ORD	NYC EWR	139 minutes	USD428.59
UA2673	2022-06-17 11:00:00	2022-06-17 14:09:00	CHI ORD	NYC LGA	129 minutes	USD318.6
DL5396	2022-06-17 11:15:00	2022-06-17 14:38:00	CHI ORD	NYC JFK	143 minutes	USD448.6
DL2571	2022-06-17 12:15:00	2022-06-17 15:38:00	CHI ORD	NYC LGA	143 minutes	USD288.6
UA5338	2022-06-17 12:30:00	2022-06-17 16:08:00	CHI ORD	NYC LGA	143 minutes	USD318.6
UA2424	2022-06-17 12:30:00	2022-06-17 16:08:00	CHI ORD	NYC EWR	143 minutes	USD428.59
UA2454	2022-06-17 14:00:00	2022-06-17 17:24:00	CHI ORD	NYC LGA	144 minutes	USD318.6
DL1674	2022-06-17 14:15:00	2022-06-17 17:38:00	CHI ORD	NYC LGA	143 minutes	USD248.6
DL4886	2022-06-17 14:27:00	2022-06-17 18:00:00	CHI ORD	NYC JFK	153 minutes	USD308.6
UA5352	2022-06-17 15:00:00	2022-06-17 18:29:00	CHI ORD	NYC LGA	149 minutes	USD288.6
UA3938	2022-06-17 15:30:00	2022-06-17 18:53:00	CHI ORD	NYC EWR	140 minutes	USD428.59
UA2446	2022-06-17 16:00:00	2022-06-17 19:30:00	CHI ORD	NYC LGA	145 minutes	USD318.6
UA1927	2022-06-17 16:08:00	2022-06-17 19:30:00	CHI ORD	NYC EWR	142 minutes	USD358.6
DL2262	2022-06-17 16:35:00	2022-06-17 20:00:00	CHI ORD	NYC LGA	145 minutes	USD248.6
UA1935	2022-06-17 17:00:00	2022-06-17 20:24:00	CHI ORD	NYC LGA	144 minutes	USD32.6
UA2391	2022-06-17 17:50:00	2022-06-17 21:10:00	CHI ORD	NYC EWR	140 minutes	USD428.59
UA1610	2022-06-17 18:00:00	2022-06-17 21:25:00	CHI ORD	NYC LGA	145 minutes	USD288.6

The screenshot shows the search results table with an advanced filter applied, specifically for "Afternoon flights (depart between 12pm - 6pm)". The results show flights from CHI ORD to NYC LGA, EWR, or JFK on June 17, 2022, with flight durations ranging from 143 to 144 minutes and total prices from USD248.6 to USD428.59.

Flight Number	Departure Date and Time	Arrival Date and Time	Departure Airport	Arrival Airport	Flight Duration	Total Price/person
DL2571	2022-06-17 12:15:00	2022-06-17 15:38:00	CHI ORD	NYC LGA	143 minutes	USD428.59
DL1674	2022-06-17 14:15:00	2022-06-17 17:38:00	CHI ORD	NYC LGA	143 minutes	USD248.6
UA5352	2022-06-17 15:00:00	2022-06-17 18:29:00	CHI ORD	NYC LGA	149 minutes	USD288.6
UA2446	2022-06-17 16:00:00	2022-06-17 19:25:00	CHI ORD	NYC LGA	145 minutes	USD288.6
DL2262	2022-06-17 16:35:00	2022-06-17 20:00:00	CHI ORD	NYC LGA	145 minutes	USD248.6
UA1935	2022-06-17 17:00:00	2022-06-17 20:24:00	CHI ORD	NYC LGA	144 minutes	USD32.6