CSE 450 Programming Assignment

April 11, 2021

Submission Instructions: Deadline is 11:59pm on 04/24. Late submissions will be penalized, therefore please ensure that you submit (file upload is **completed**) before the deadline. Additionally, you can download the submitted file to verify if the file was uploaded correctly. Submit your answers electronically, in a **single zip file**, via Canvas. The zip file should contain your source code along with a report (PDF) of your findings. **Your source code can be any of the following: C, C++, Java, Python and/or Matlab.**

Problem: In this programming assignment, you are tasked with the computation of the capacity of a simplified model of the National Airspace System (NAS), between *Source: Los Angeles (LAX) and Destination: New York City (JFK), in a 24 hour time period, starting at 12:00AM and ending at 11:59 PM.* The dataset is based on the data available for a particular day. Apart from these two airports, our simplified NAS consists of the following airports (codes) as well - San Francisco (SFO), Phoenix (PHX), Seattle (SEA), Denver (DEN), Atlanta (ATL), Chicago (ORD), Boston (BOS) and Washington DC (IAD). Furthermore, you can assume that our simplified NAS consists of three airlines: American Airlines (AA), Delta Airlines (DL) and United Airlines (UA).

To compute the capacity of the NAS on that day, you should consider the following - (i) all direct (non-stop) flights between LAX and NYC, and (ii) multi-stop flights between the two cities, *provided the stops are airports in the list above.* If the stops are not airports mentioned in the list above, you can discard that itinerary. For instance, you can discard LAX to MIA to NYC, since Miami airport (MIA) is not in our model. You can include instances like (i) a non stop flight from LAX to NYC, and (ii) a multi-stop flight which could take you from LAX to SFO to ATL to NYC. While considering the above two scenarios, please keep in the mind the following: *only consider flights which depart LAX and arrive at NYC on the same day.* **For multi-stop flights, the flight departing LAX may not be the same flight which arrives at NYC**. For instance, a passenger might fly from LAX to PHX on AA, PHX to ATL on DL and ATL to NYC on UA. For the computation of capacity of such a system, you must satisfy the following:

- A passenger can only travel from LAX to NYC.
- For multi-stop itineraries, a passenger can take any of the 3 airlines to travel between two cities (one itinerary may have all the three airlines).
- For multi-stop itineraries, the arrival time of a flight at an intermediate stop must be less than the departing time of the next flight from that very same intermediate stop.

If these three constraints are satisfied for at least 1 passenger, then the capacity of the system is at least 1. Furthermore, you may assume that transit times in an intermediate airport can be 0 units of time. In other words, if a flight arrives at 11:00 and another flight departs at 11:00, then a passenger could take the departing flight provided the number of passengers on the flight do not exceed the capacity of the plane.

Datasets: We will be uploading a sample timetable which includes flight information for all three airlines. The first column is the source airport, the second column is the destination airport, the third column indicates the departure time, the fourth column indicates the arrival time and the final column indicates the capacity of that flight. The filename is "flights.txt".

Deliverable: A zip file containing your source code along with a report (PDF) of your findings. **The report can be of any length and must describe your process and clearly state the capacity you determined following your process**. Finally, your report should also contain any additional instructions we may need to compile and run your program.

Hint: To accomplish this task, you might be thinking in similar lines with the process of *"constructing a directed graph with all the cities represented as nodes and directed edges from a node A to B if there is a flight travelling from city A to city B". However, such a graph only captures the spatial information (flights between cities) and not the temporal information (time of the flights). Thus, such an approach is incomplete and is not going to capture the entire picture. The graph you create should capture the temporal aspect of the task as well, in order to accurately capture the capacity of the NAS. For further simplification, you can round the flight times (departure and arrival) to the nearest hour.*