

CSE 551 Programming Assignment

November 12th, 2019

Submission Instructions: Deadline is 11:59pm on 11/26. 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 finding (network capacity). 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) on January 6, 2020, in a 24 hour time period, starting at 12:00AM and ending at 11:59 PM*. 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 on 01/06/2020 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 the computation of capacity of such a system, you must satisfy the following:

- A passenger can only travel from LAX to NYC on January 6th, 2020.
- 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.

Data Collection: To collect the required information you can visit the sites of the respective airlines and grab all the itineraries which satisfy the above constraints. For instance, the timetable for AA is available here: <https://www.aa.com/travelInformation/flights/schedule>. Just plug in the source and destination cities to get all the flights between them (non-stop and multi-stop, along with aircraft type). Knowing the aircraft type is critical, because these will form the edge weights (capacities) between two nodes (for example if AA is operating the Airbus A320neo between two cities/nodes, then the capacity of that edge will be 165). You can look up Wikipedia for the specifications (maximum seating capability) of the aircraft. Once you have collected the data, you need to compute the capacity of the NAS for that day.

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 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.