

Data Structures and Algorithms CW2

FlyPlanner

F28DA

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HelloFlyPlanner

The HelloFlyPlanner class is used to represent direct flights and least cost connections. It represents the given set of airports as a graph.

A string of cities and a scanner object to take in user input is initialized at the beginning. Then a SimpleDirectedWeightedGraph is initialized with String as vertex and DefaultWeightedEdge as edge. The string holds the city name while the DefaultWeightedEdge holds the flight route & price.

The cities are added as vertices, and the flight routes along with the price are added as the edges of the graph. A table is printed for the user to see all the possible routes along with their prices. String.format() is used to align the display in the table.

The user is then asked to enter the starting city and the destination city. 'While' loops are used to check if the city entered by the user is present in the graph. If the user inputs the same city as origin and destination, he is asked to enter a different destination airport.

A DijkstraShortestPath graph is initialized to store the graph, while a GraphPath is created using the Dijkstra graph.

By iterating through all the edges in the graph path, we print out the itinerary.

Part A

In part A, I have implemented the functions in AirportImpl.java, FlightImpl.java and TripImpl.java classes.

The FlightImpl.java class has a constructor that takes in a string of data, AirportImpl object 'to' and AirportImpl object 'from' as arguments. The string of data holds the flightCode, fromGMTime, toGMTime and cost.

The AirportImpl.java class has a constructor that only takes a string of data as arguments. The string of data holds the airport code and airport name.

The TripImpl.java class has a constructor that takes a List of FlightImpl objects, since the trip might need more than one flight.

The FlyPlannerImpl.java is the class that creates the functionality of the graph. The populate() method adds the vertices and edges for the graph. The airports are the vertices, flights are the edges, and the costs are the edge weights of the SimpleDirectedWeightedGraph.

The leastCost() uses a DijkstraShortestPath graph to calculate a path between two airports with the least cost. The algorithm makes use of the edge weight of the graph, which is the cost. It returns a TripImpl object which stores the edge list of the path.

The leastHop() is similar to the leastCost(), but instead of DijkstraShortestPath, I have used a AsUnweightedGraph so as to remove the edge weights. Therefore, the path will be calculated based on the shortest path.

Both leastCost() and leastHop() will be overloaded if the user chooses to exclude certain airports in the trip, by passing a List of airports to be excluded as an argument. leastCost() is implemented in the main function.

Part B

For part B, I have implemented the functions in AirportImpl.java, FlightImpl.java, TripImpl.java and FlyPlannerImpl.java which were previously left unfinished.

Helper function to convert time from hours and minutes format to minutes has been implemented in TripImpl.java and FlyPlannerImpl.java. Both helper functions are the same, with the code being reused within the project.

The leastCostMeetUp() takes in two arguments, departure, and arrival airport. Then a DijkstraShortestPath graph is used to plot a GraphPath between the two

travellers. All the vertices are then added to an airport list, where the vertices are the airports between the two travellers. A middle index is then found, which is the meeting point for both the travellers.

The `leastHopMeetUp()` is similar to the `leastCostMeetUp()` but uses a `AsUnweightedGraph` instead. This removes the edge weights, which is the cost. Thus, we get a path with the least hops.

The `leastTimeMeetUp()` is not yet complete.

`directlyConnected()`, `setDirectlyConnected()`, `setDirectlyConnectedOrder()` and `getBetterConnectedInOrder()` are either incomplete or not attempted due to my limited understanding of these method's functionality.

Limitations

There are a few limitations to my code.

Firstly, the main function does not print the departing and arrival airport while displaying the itinerary. It prints the other data correctly, but I am not able to print the airport names. I am getting a `nullPointerException` when I try to print the names.

Secondly, in the main function, while printing a trip with airports to be excluded, the user can only exclude one airport.

Testing

Only 6 tests pass in the provided test file. I have added my own tests in the test file, where 1 test fails. The test that fails is testing the `directlyConnected()`.

```
eclipse-workspace - I28da-2020-21-cw2/src/F28DA_CW2/HelloFlyPlanner.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project PyDev Run Window Help

HelloFlyPlanner [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Mar 30, 2021, 11:53:14 PM - 11:53:28 PM)
Use similar code to build the small graph from Preliminary Part B by hand.
Note that you will need to use a different graph class as SimpleGraph since your graph is not just a Simple Graph.
Once you understand how to build such graph by hand, move to Part A to build a more substantial graph.
-- toString output
[[v1, v2, v3, v4], [[v1,v2], (v2,v3), {v3,v4}, {v4,v1}]]

-----
The table below shows all the possible flights with their prices.
-----
Flights      Cost
-----
Edinburgh --> Heathrow $80.0
Edinburgh --> Dubai $190.0
Heathrow --> Edinburgh $80.0
Heathrow --> Sydney $570.0
Heathrow --> Dubai $130.0
Dubai --> Kuala Lumpur $170.0
Dubai --> Heathrow $130.0
Dubai --> Edinburgh $190.0
Sydney --> Heathrow $570.0
Sydney --> Kuala Lumpur $150.0
Kuala Lumpur --> Dubai $170.0
Kuala Lumpur --> Sydney $150.0

Enter your departure city from the table:
Dubai
Enter your destination city from the table:
Sydney
You are starting your trip from Dubai and ending it at Sydney

The shortest path from Dubai to Sydney is:
Connection 1: Dubai --> Kuala Lumpur
Connection 2: Kuala Lumpur --> Sydney
Total cost: $320.0
```

HelloFlyPlanner.java running

```
eclipse-workspace - I28da-2020-21-cw2/src/F28DA_CW2/HelloFlyPlanner.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project PyDev Run Window Help

HelloFlyPlanner [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Mar 30, 2021, 11:54:03 PM - 11:54:15 PM)
[[v1, v2, v3, v4], [[v1,v2], (v2,v3), {v3,v4}, {v4,v1}]]

-----
The table below shows all the possible flights with their prices.
-----
Flights      Cost
-----
Edinburgh --> Heathrow $80.0
Edinburgh --> Dubai $190.0
Heathrow --> Edinburgh $80.0
Heathrow --> Sydney $570.0
Heathrow --> Dubai $130.0
Dubai --> Kuala Lumpur $170.0
Dubai --> Heathrow $130.0
Dubai --> Edinburgh $190.0
Sydney --> Heathrow $570.0
Sydney --> Kuala Lumpur $150.0
Kuala Lumpur --> Dubai $170.0
Kuala Lumpur --> Sydney $150.0

Enter your departure city from the table:
Dubai
Enter your destination city from the table:
Sydney
city is not present in the table.
Please enter your destination city again.(Make sure your spellings are correct!)
Sydney
You are starting your trip from Dubai and ending it at Sydney

The shortest path from Dubai to Sydney is:
Connection 1: Dubai --> Kuala Lumpur
Connection 2: Kuala Lumpur --> Sydney
Total cost: $320.0
```

HelloFlyPlanner.java with erroneous usage

```
eclipse-workspace - f28da-2020-21-cw2/src/F28DA_CW2/FlyPlannerMain.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Pydev Run Window Help

Console
-terminated- FlyPlannerMain [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Mar 30, 2021 11:58:39 PM - 11:58:54 PM)
Hey Dude! I see you have come here to find out more about that trip you were planning to take.
Follow the steps below and you'll get what you came for!

Please enter the airport code from where you would like to depart :
NCL
Please enter the airport code where you would like to end your trip :
NTL
You are travelling from Newcastle(NCL) to Newcastle(NTL). Nice choice dude!
Do you want to exclude any airports? Enter YES OR NO
NO
Leg      Leave      At      On      Arrive      At
1         null      1918    KL7893    null      2004
2         null      0747    CX0831    null      1702
3         null      0748    CX7100    null      1427
4         null      1628    QF0640    null      1729

Total Cost: $1035
Total Time in the Air: 1061 mins
Total Connection Time: 1710 mins
Total connections: 4
Total time of the trip: 2771 mins

201M of 256M
```

```
eclipse-workspace - f28da-2020-21-cw2/src/F28DA_CW2/FlyPlannerMain.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Pydev Run Window Help

Console
-terminated- FlyPlannerMain [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Mar 30, 2021 11:59:20 PM - 11:59:32 PM)
Hey Dude! I see you have come here to find out more about that trip you were planning to take.
Follow the steps below and you'll get what you came for!

Please enter the airport code from where you would like to depart :
NCL
Please enter the airport code where you would like to end your trip :
ncl
Please enter a valid airport code. (Check your spelling or your CAPS LOCK)
NCL
You are starting and ending at the same place. Change your destination dude!
NTL
You are travelling from Newcastle(NCL) to Newcastle(NTL). Nice choice dude!
Do you want to exclude any airports? Enter YES OR NO
NO
Leg      Leave      At      On      Arrive      At
1         null      1918    KL7893    null      2004
2         null      0747    CX0831    null      1702
3         null      0748    CX7100    null      1427
4         null      1628    QF0640    null      1729

Total Cost: $1035
Total Time in the Air: 1061 mins
Total Connection Time: 1710 mins
Total connections: 4
Total time of the trip: 2771 mins

145M of 256M
```

```
eclipse-workspace - f28da-2020-21-cw2/src/F28DA_CW2/FlyPlannerMain.java - Eclipse IDE
File Edit Source Refactor Navigate Search Project Pydev Run Window Help

Console
-terminated- FlyPlannerMain [Java Application] C:\Program Files\Java\jre1.8.0_261\bin\javaw.exe (Mar 30, 2021 11:59:42 PM - 11:59:53 PM)
Hey Dude! I see you have come here to find out more about that trip you were planning to take.
Follow the steps below and you'll get what you came for!

Please enter the airport code from where you would like to depart :
NTL
Please enter a valid airport code. (Check your spelling or your CAPS LOCK)
NTL
Please enter the airport code where you would like to end your trip :
NCL
You are travelling from Newcastle(NTL) to Newcastle(NCL). Nice choice dude!
Do you want to exclude any airports? Enter YES OR NO
YES
Enter DONE if you dont want to exclude any more airports
DONE
Leg      Leave      At      On      Arrive      At
1         null      1311    QF4949    null      1403
2         null      0106    QF3723    null      0836
3         null      1102    BA3730    null      2009
4         null      1428    BA2807    null      1510

Total Cost: $1050
Total Time in the Air: 1091 mins
Total Connection Time: 1908 mins
Total connections: 4
Total time of the trip: 2999 mins

151M of 256M
```

FlyPlannerMain running with erroneous usage. It also shows a trip with one airport excluded.