Final Project Presentation

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Project Goals

- Acquire Data from an online site, specifically with airports and flights
- Create a BFS traversal traversing through all the connecting flights and their paths between two airports.
- Implement Dijkstra’s Algorithm to find the shortest path between two airports, while also using a variable factor to account for airports that may come in the middle.
- Implement Kruskal’s algorithm to find the shortest cycle and path between all the airports

Source of Data

- Got this data from OpenFlights, in which we put download the data file from their website and read from this file to build graph
- Airports.dat, which has an airport ID, name, and longitude and latitude
- Routes.dat, in which we used the route destination ID and the route source ID

Creating the Graph

- Basic Graph implementation, in which it is both directed and weighted
- Vertices are implemented as the airports that we read from the airport.dat file
- Edges are implemented through the routes.dat file that we read from,
- Edges are also directed and weighted to fulfill the basic implementation

BFS

- Idea behind this is to search wide before deep into the graph
- Visits the neighbors of a node first before visiting the neighbors of the neighbors
- Can be used to find shortest path, but not in this case because graph is weighted
- First created a visited map, with the vertex string as the key and a bool value for its value, and initialize all these values as false
- Create a source node and a queue in which we push the source node
- Create a while loop and loop until the queue is empty
  - Pop that node
  - Add to overall list
  - Visit all of that node’s neighbor, and if they are not visited, then mark visit as true and push into queue
  - Print the overall list

Dijkstras

- Accepts a graph, start airport, and end airport and returns the minimum connecting distance between them
- Initialize map of distance and path, and initialize priority queue to iterate through
- Iterate through the current nodes neighbors and add each nodes distance from the source
- Print out the final distance in the distance map

Kruskals

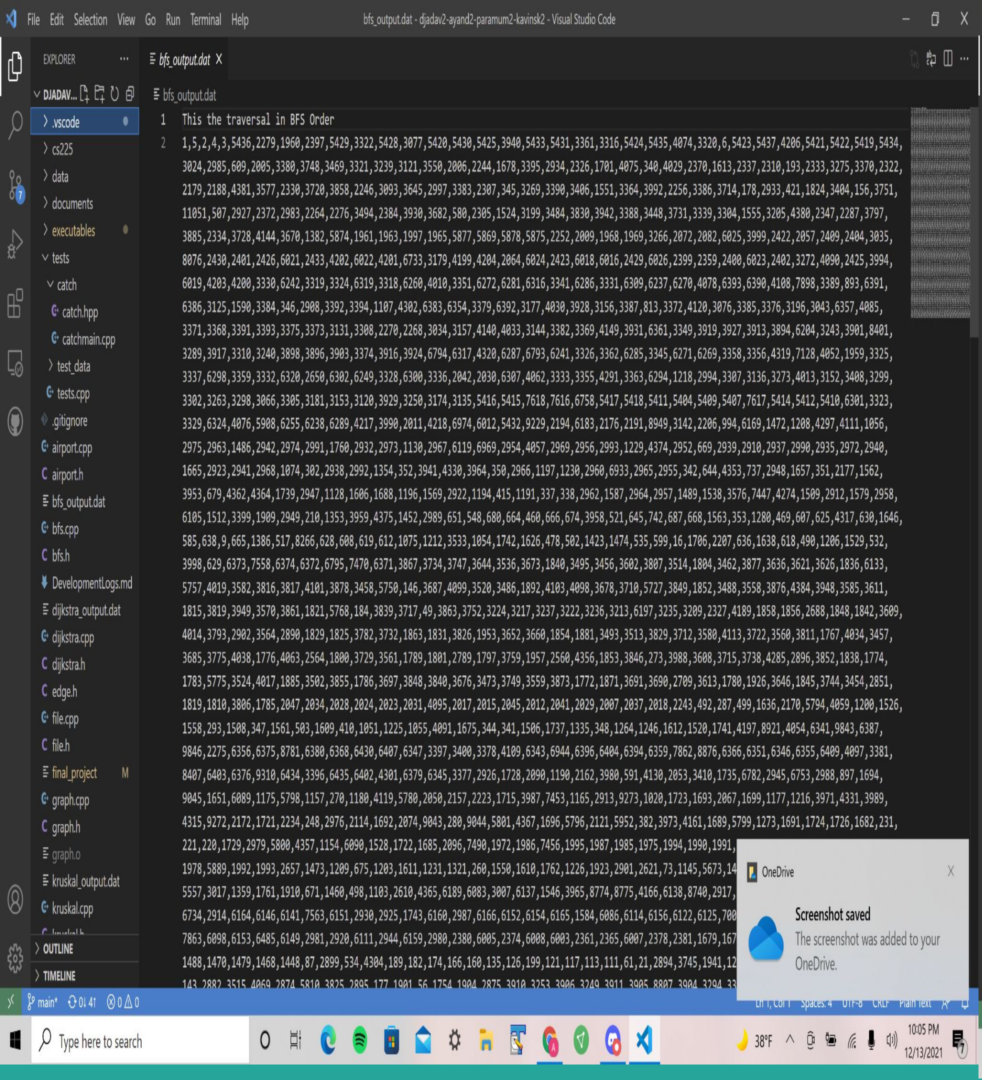
- Kruskals is a type of minimum spanning tree algorithm that inserts the edges from lowest weight to highest weight
- Also prevents a full cycle from being inserted with the edges
- First, get the edges of the graph and sort them
- Associated each edge with a number
- Initialized a disjoint set for each vertex
- If the vertices for each edge are in different sets, then add the weight to the overall result and union these sets together

Testing

- Checked if graph was made correctly first
  - Checked if bad routes were ignored, if the airport constructor was correct implemented, and if distance was calculated correctly
- For BFS, Dijkstras, and Kruskals, we made basic test cases with a graph with generated edges
  - BFS has test cases of the size and the order of the first few objects in the traversal
  - Dijsktras has test cases of calculating the shortest distance between two different nodes in a basic generated graph
  - Kruskals has test cases with the basic graph and tests if it follows the the correct order

Results/Conclusion

- Saved the traversal and algorithm data to their respective .dat files
- With Dijkstras, we were able to find the shortest path between any two given cities, which was interesting to implement when using real data
- Additionally, Kruskals gave us the shortest way to go to every airport.
- While not applicable in real life, it was still cool to see this and how the graph plays out with data
- Struggled in the beginning with building the project with nothing to build off on unlike previous mps, but was still fun to do when finally done with it



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This the traversal in BFS Order
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3289,3917,3310,3240,3898,3896,3903,3374,3916,3924,6794,6317,4320,6287,6793,6241,3326,3362,6285,3345,6271,6269,3358,3356,4319,7128,4052,1959,3325,
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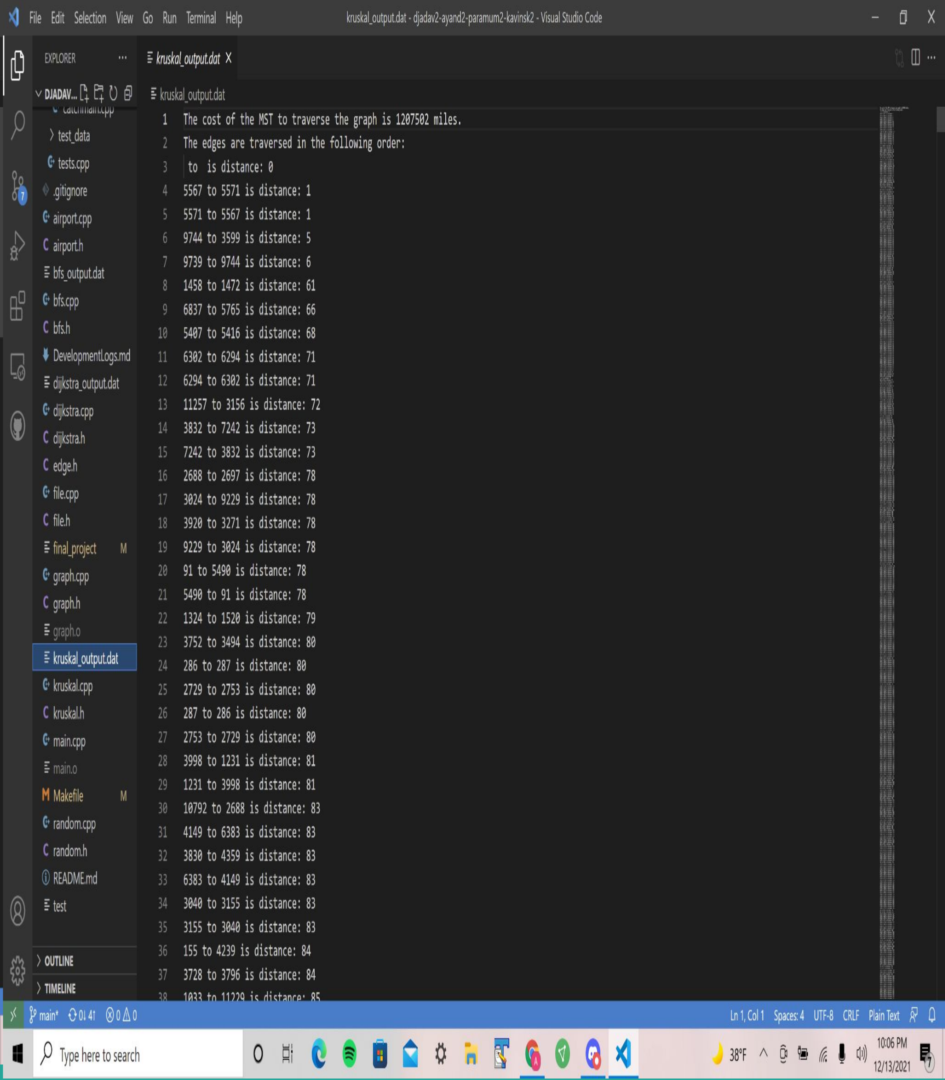
OneDrive

Screenshot saved

The screenshot was added to your OneDrive.



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The cost of the MST to traverse the graph is 1207502 miles.
The edges are traversed in the following order:
 to  is distance: 0
5567 to 5571 is distance: 1
5571 to 5567 is distance: 1
9744 to 3599 is distance: 5
9739 to 9744 is distance: 6
1458 to 1472 is distance: 61
6837 to 5765 is distance: 66
5407 to 5416 is distance: 68
6302 to 6294 is distance: 71
6294 to 6302 is distance: 71
11257 to 3156 is distance: 72
3832 to 7242 is distance: 73
7242 to 3832 is distance: 73
2688 to 2697 is distance: 78
3024 to 9229 is distance: 78
3920 to 3271 is distance: 78
9229 to 3024 is distance: 78
91 to 5490 is distance: 78
5490 to 91 is distance: 78
1324 to 1520 is distance: 79
3752 to 3494 is distance: 80
286 to 287 is distance: 80
2729 to 2753 is distance: 80
287 to 286 is distance: 80
2753 to 2729 is distance: 80
3998 to 1231 is distance: 81
1231 to 3998 is distance: 81
10792 to 2688 is distance: 83
4149 to 6383 is distance: 83
3830 to 4359 is distance: 83
6383 to 4149 is distance: 83
3040 to 3155 is distance: 83
3155 to 3040 is distance: 83
155 to 4239 is distance: 84
3728 to 3796 is distance: 84
1033 to 11229 is distance: 85
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Future Development

- For now, we just added the base features to the project
- Includes the traversal and two algorithms for finding the shortest path and shortest time to pass through all of the airports
- This are just the base features, and we can add extra features to the project
- For example, a variable factor that takes into account which airport is closer to the starting airport if we have one connecting flight