***Data Structure Project***

**Group Members:**

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**Purpose**

The purpose of the project was to implement networking of routers. The project was divided into two phases.

**Phase 1:**

**Introduction:**

The first phase was to implement the functionality of routers. This included the making of the router class. The router class consists of the priority queue as the incoming queue, this saves the incoming message from the source machine/ router and then it further sends this queue as the outgoing queue to the next routers/ machines incoming queue. This is continued until the message is reached to the destination. For this purpose, we are also making the routing table, and did this with two different methods, one with link lists and the other with splay trees.

We were asked to implement a series of commands which included, the send message command that would send the message from the source to the destination. The next command was to change the routing table, followed by the printing of the path, after which there was the queries section where we had to handle few of the queries.

**Difficulties Faced:**

The implementation of the routing tables was challenging, and quite difficult to comprehend. Firstly, to splay function was difficult to implement as there were many errors evolving regarding this function. This took a lot of our time and we had to use many sources to figure out the errors. Secondly, the construction of routing table was challenging, the implementation of Dijkstras algorithm on the incoming queue keeping in mind the priority of the messages was difficult as we had to firstly extract the message with the highest priority and then use the Dijkstras algorithm on it to find the shortest path to the destination.

Reading the csv file was also a challenge that we faced as we have always worked on text files and did not had the knowhow of how to read the csv file.

One of the major difficulties was the implementation of splay trees, splay trees have not been discussed in class and hence we had to use other online sources to try and understand how splay trees work before implementing them. Furthermore, the errors and exceptions relating to this were new to us and hence took a lot of our time to resolve issues. Hence, this resulted in a constraint of time.

**Implementation and Details of Functions:**

Firstly, we made the class of link list. This was made as we did so in the labs throughout the semester and we did not face much problems in its implementation.

After this we made the class of nodes and q node which was the nodes being used for the implementation of the queues that were used for incoming messages and outgoing messages which were queues, we implemented their functions such as enqueue, dequeue and other specific functions which were then used to implement the priority queue (min heap).

We also implemented the functions and class of splay trees and other related functions to it. This was done by taking some help from online sources and youtube where we searched about how to implement the splay trees and their related functions.

Another class of the graph was implemented as well that was used to make the graph and evaluate the graph loading process which was demanded of us. This was also done using the lab tasks that we covered in labs and this helped us get a 2d matrix that will give us the data of all the edges from the vertices.

We then implemented the global functions that were used throughout the code such as the dijkstras algorithm which was used to find the shortest possible path from the source to the destination. This function was helpful when making the routing table implementation. As the routing table was filled according to the shortest path that we achieved through this algorithm. Other such functions were that of reading the csv file. This was done through file handling that we have implemented taking help from online sources.

We then implemented the menu to let the user choose between whether to work with link lists or to work with splay trees.

We also made the function of send message, this message was used to create new message objects. This was done by removing the \n new lines from the code, and then reading the string from the file. This was then stored in a message object which was then used for further processing.

There are relations with the classes of link lists and nodes. As we have created head, front, rear nodes in the classes of link list and queue. Then we made relations between the class of message and priority queue.

We also added the member instances of priority queue, queue in the class of routers where we used it to access the source the destination and the path along which the message will go.

**Phase 2:**

**Introduction:**

Phase 2 is an extension of phase 1 where in phase 1 we used single routers to send the messages from the source to the destination and here in phase 2 we are using and implementing a series and network of routers to implement the functionality of sending the messages from the source to the destination, and as here we are using a network of routers to implement the functionality this allows us to send more than one message at a time and we also are using more than one sources and destinations simultaneously.

Here we also had to implement interrupts, which would be based on priority and would stop the message sending process and work on the interrupt generated.