LAB 11

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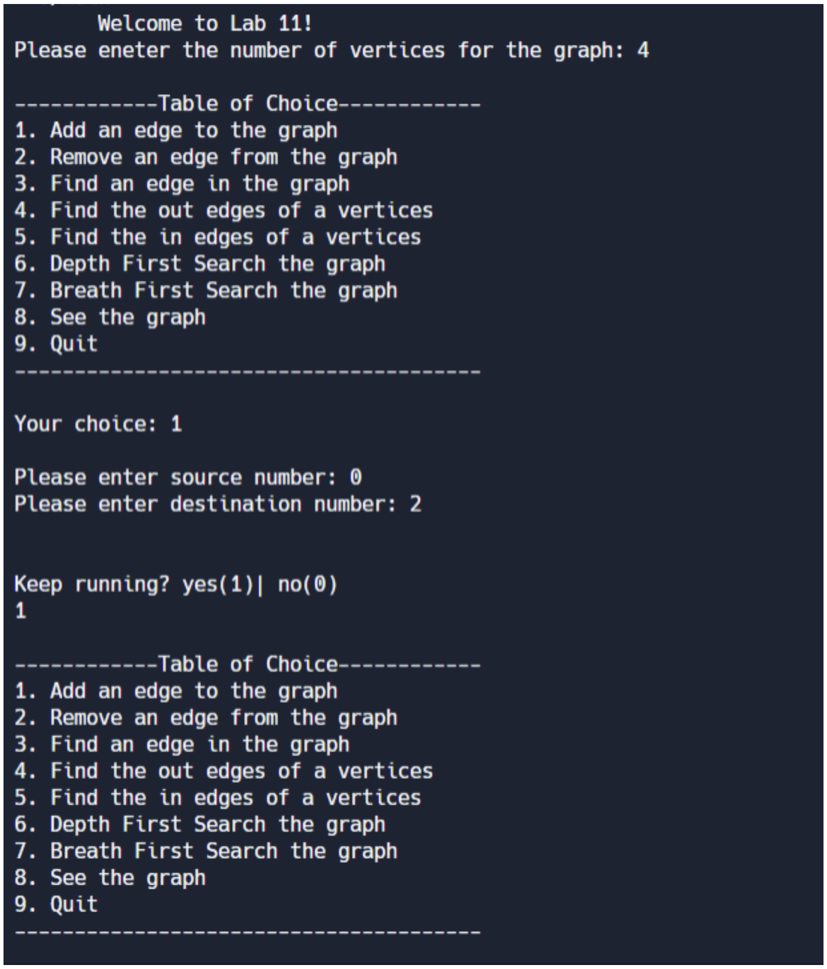
A description of the objectives/concepts explored in this assignment including why you think they are important to this course and a career in CS and/or Engineering.

The objective of this lab is to explore creating and traversing graphs. Graph is a type of data structure that has a lot of applications in our real life. Google Map is built using Graph Algorithms. By exploring the graph, we got a chance to get out of how the graph works and how to implement it. Traversing the graph is a difficult task since you must get to their vertex then loop through every node in the vertex to see if they are connected then move to another vertex, which requires much understanding about graph. Overall, by understanding graph, we could use it to apply to our real work later by creating a duplicate of Google Map for example.

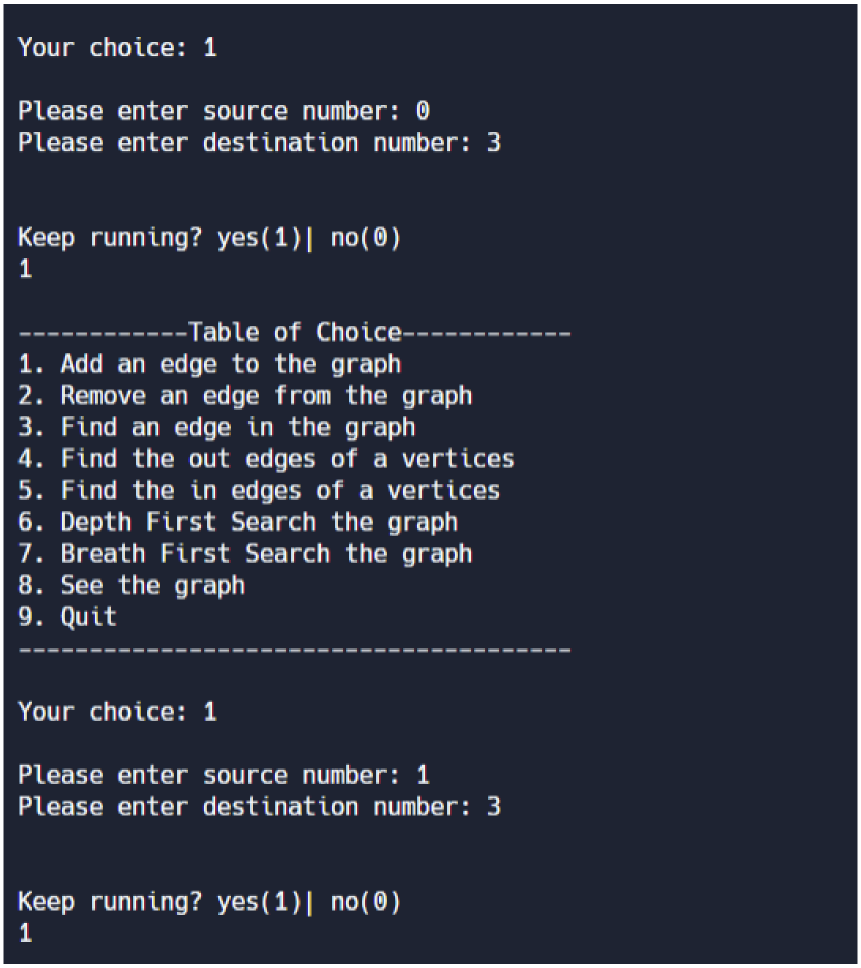
The sections from each task

- The program was programmed via Replit.

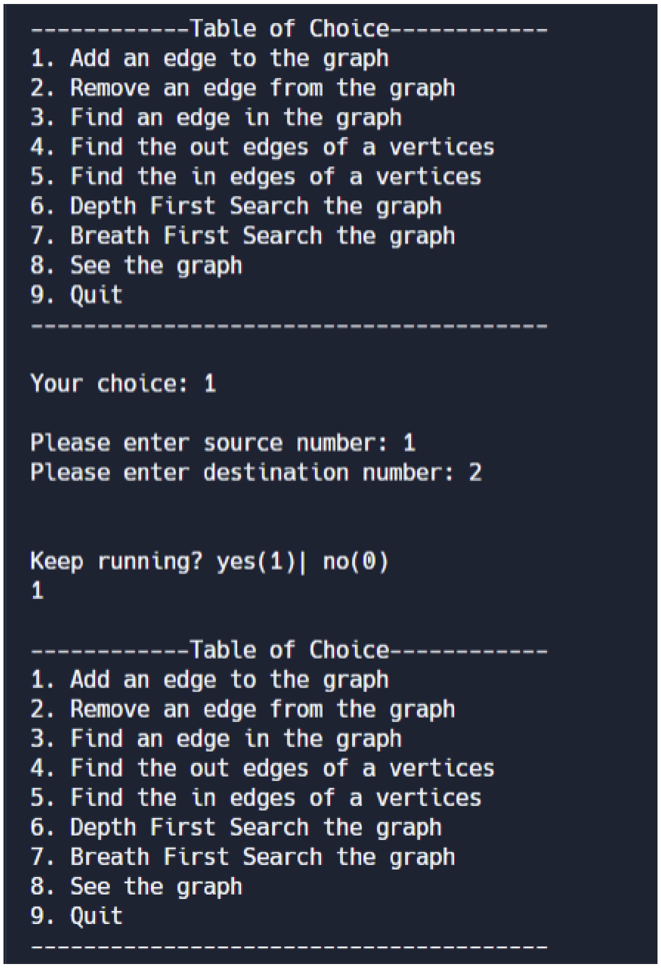
Task 2:



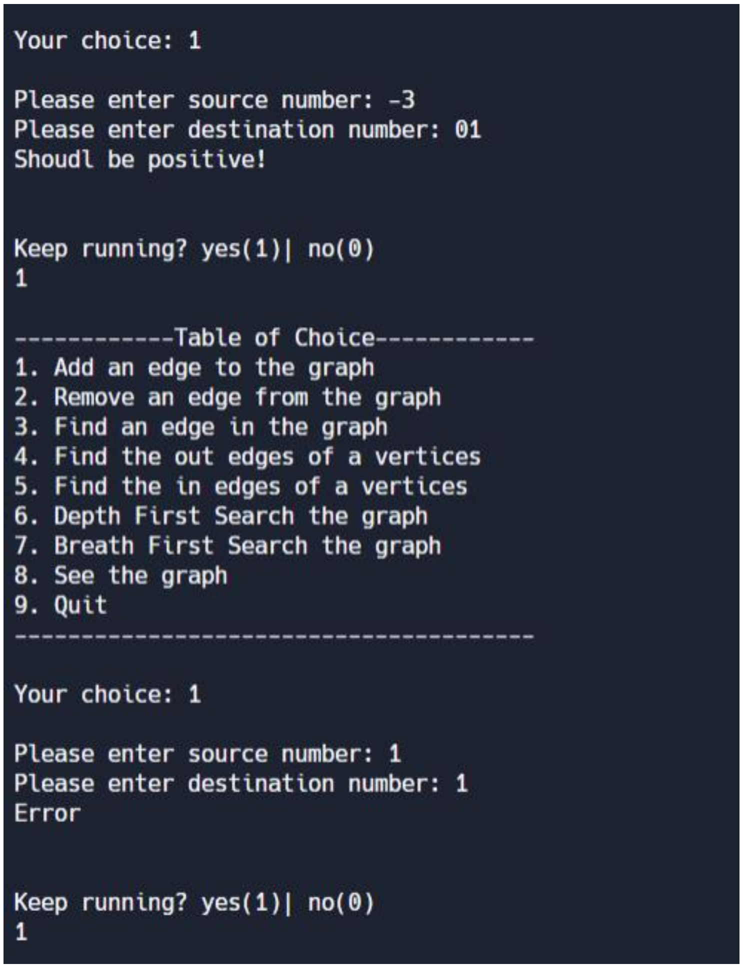
```
       Welcome to Lab 11!
Please eneter the number of vertices for the graph: 4

------------Table of Choice-----------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 0
Please enter destination number: 2


Keep running? yes(1)| no(0)
1

------------Table of Choice-----------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------
```



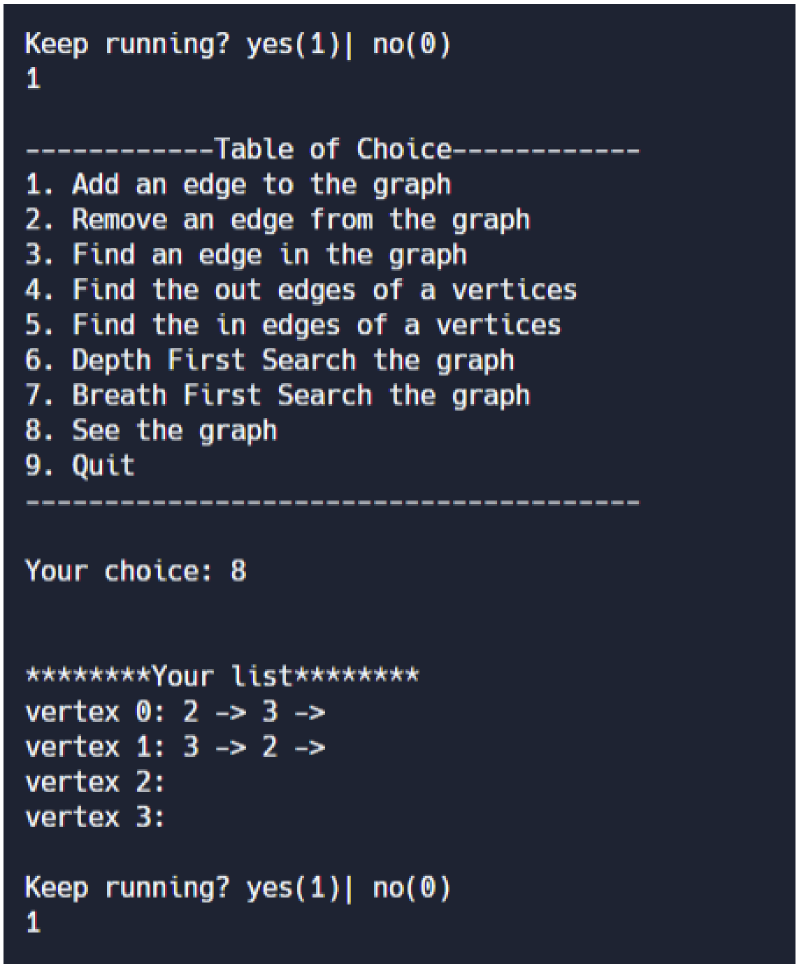
```
Your choice: 1

Please enter source number: 0
Please enter destination number: 3


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 1
Please enter destination number: 3


Keep running? yes(1)| no(0)
1
```



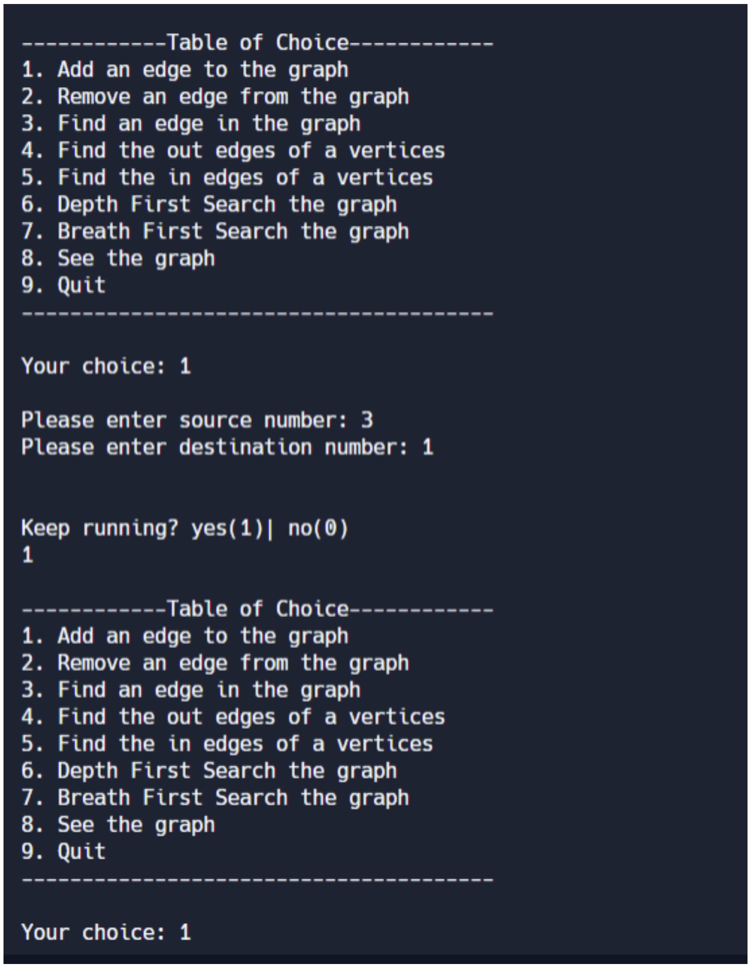
```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 1
Please enter destination number: 2


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------
```



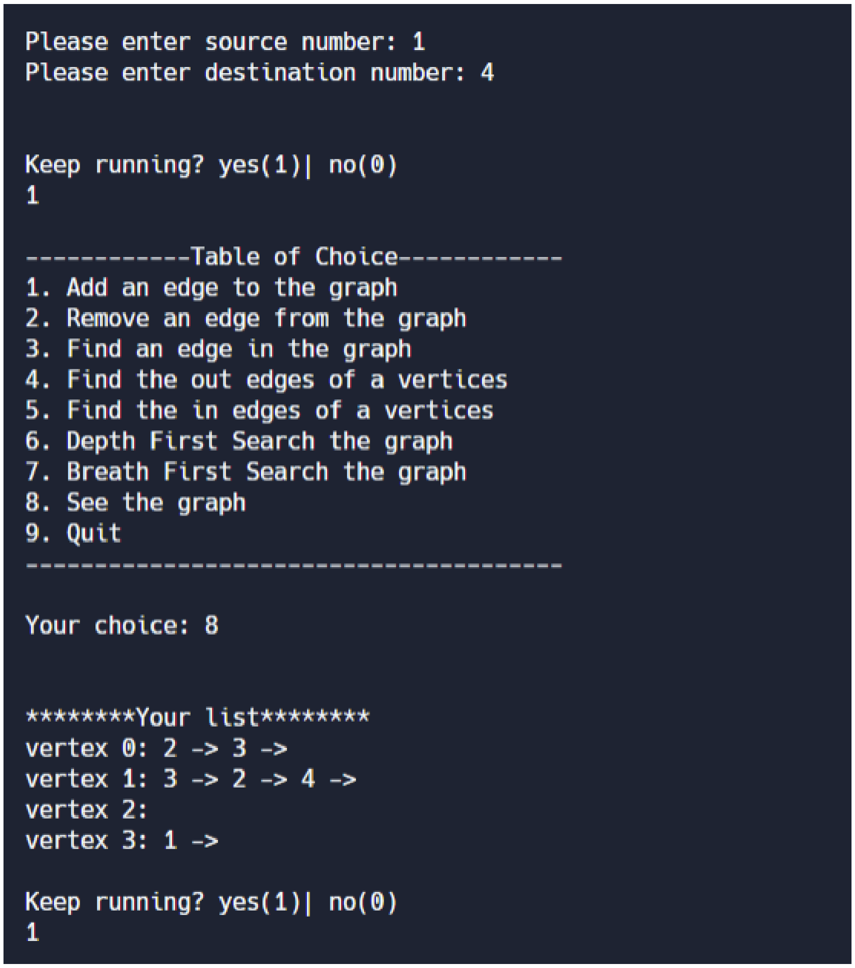
```
Your choice: 1

Please enter source number: -3
Please enter destination number: 01
Shoudl be positive!


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 1
Please enter destination number: 1
Error


Keep running? yes(1)| no(0)
1
```



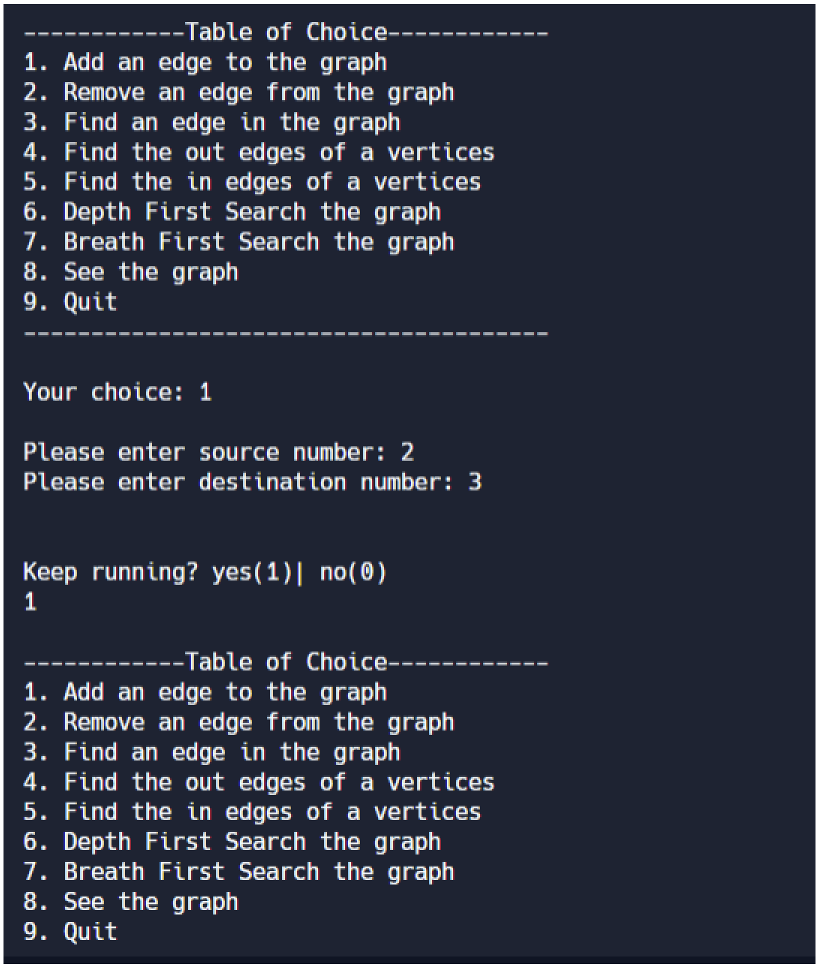
```
Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 8


********Your list********
vertex 0: 2 -> 3 ->
vertex 1: 3 -> 2 ->
vertex 2:
vertex 3:

Keep running? yes(1)| no(0)
1
```



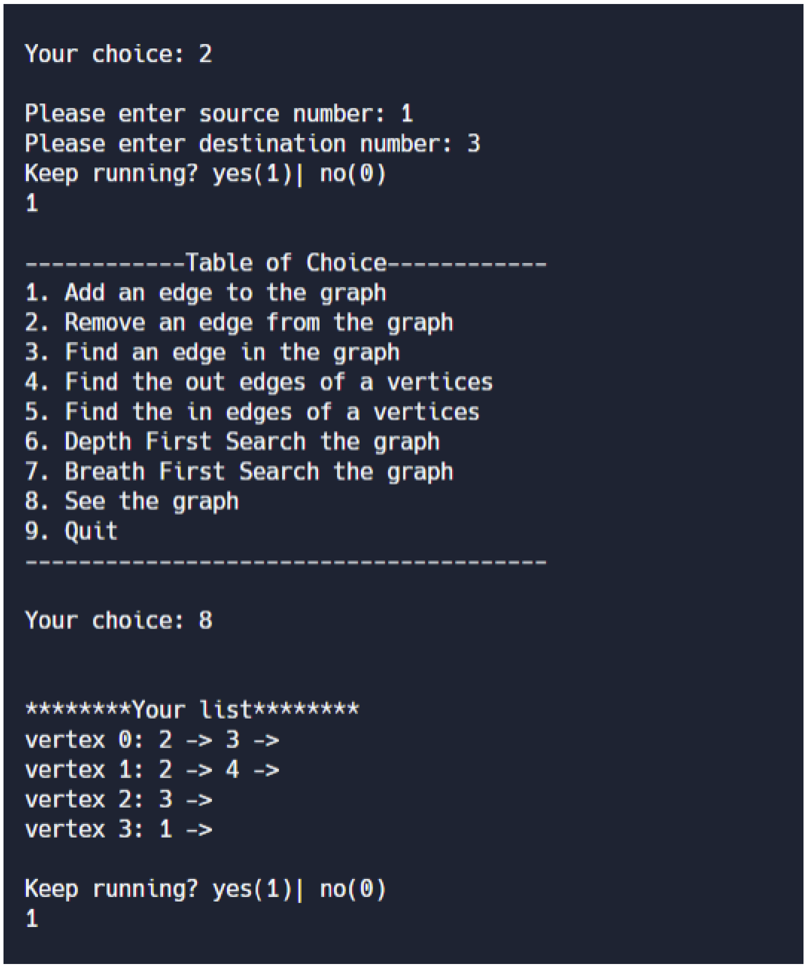
```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 3
Please enter destination number: 1


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1
```



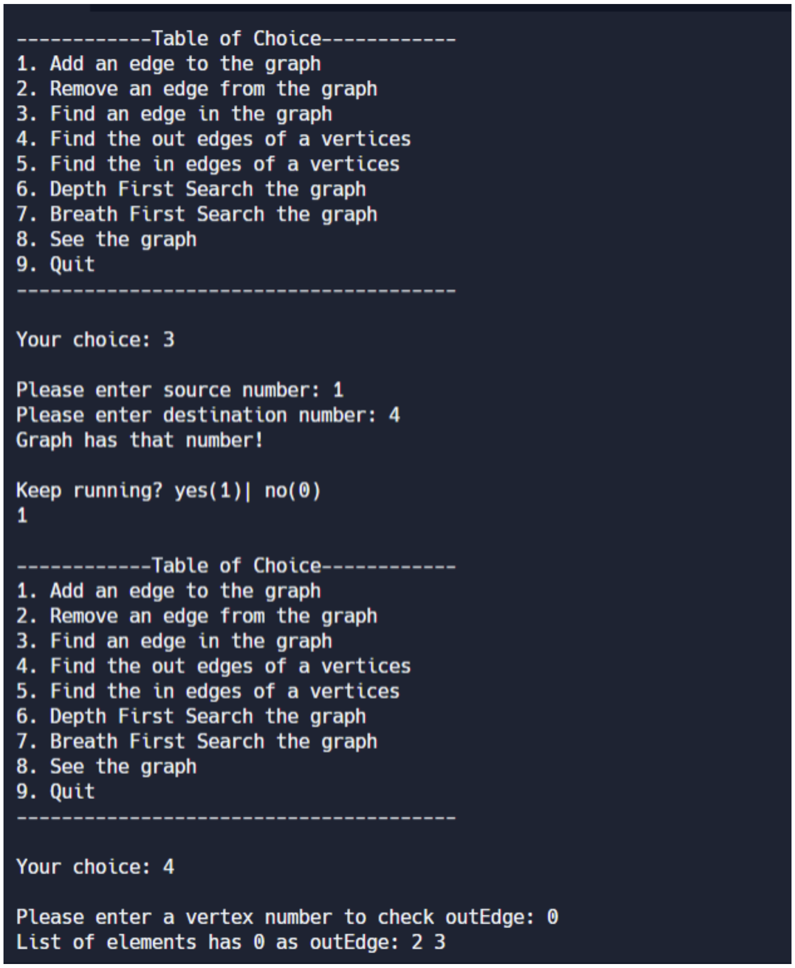
```
Please enter source number: 1
Please enter destination number: 4


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 8


********Your list********
vertex 0: 2 -> 3 ->
vertex 1: 3 -> 2 -> 4 ->
vertex 2:
vertex 3: 1 ->

Keep running? yes(1)| no(0)
1
```



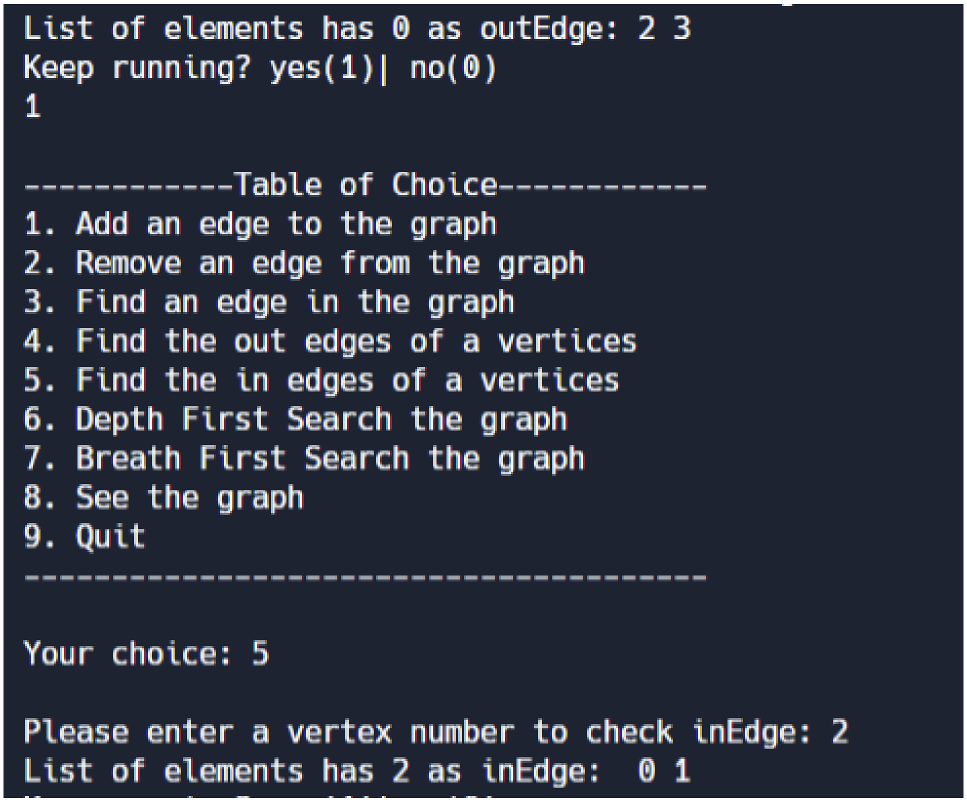
```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 2
Please enter destination number: 3


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
```



```
Your choice: 2

Please enter source number: 1
Please enter destination number: 3
Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 8


********Your list********
vertex 0: 2 -> 3 ->
vertex 1: 2 -> 4 ->
vertex 2: 3 ->
vertex 3: 1 ->

Keep running? yes(1)| no(0)
1
```

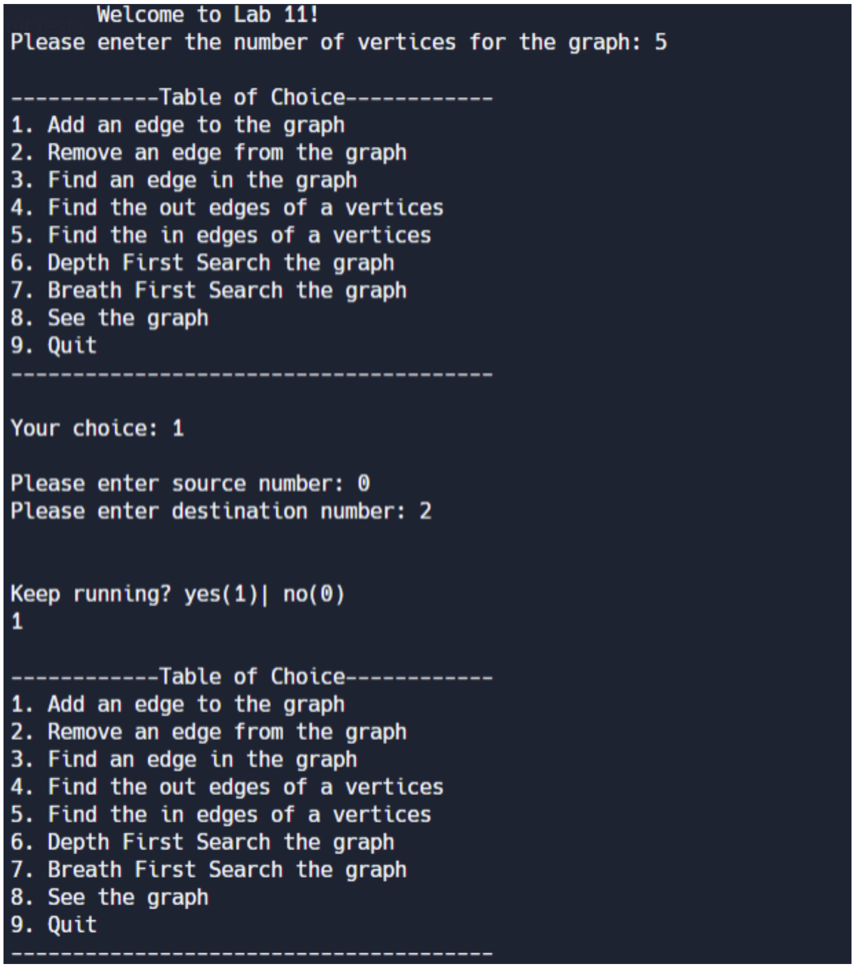


```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 3

Please enter source number: 1
Please enter destination number: 4
Graph has that number!

Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 4

Please enter a vertex number to check outEdge: 0
List of elements has 0 as outEdge: 2 3
```

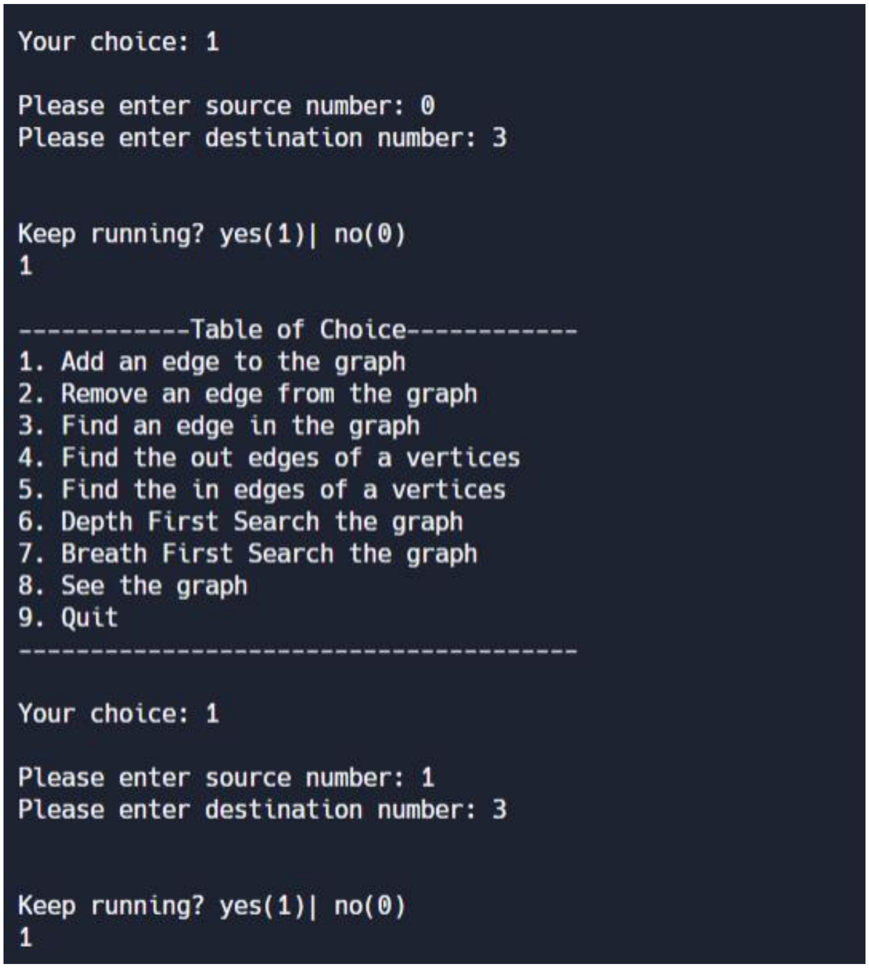


```
List of elements has 0 as outEdge: 2 3
Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 5

Please enter a vertex number to check inEdge: 2
List of elements has 2 as inEdge:  0 1
```

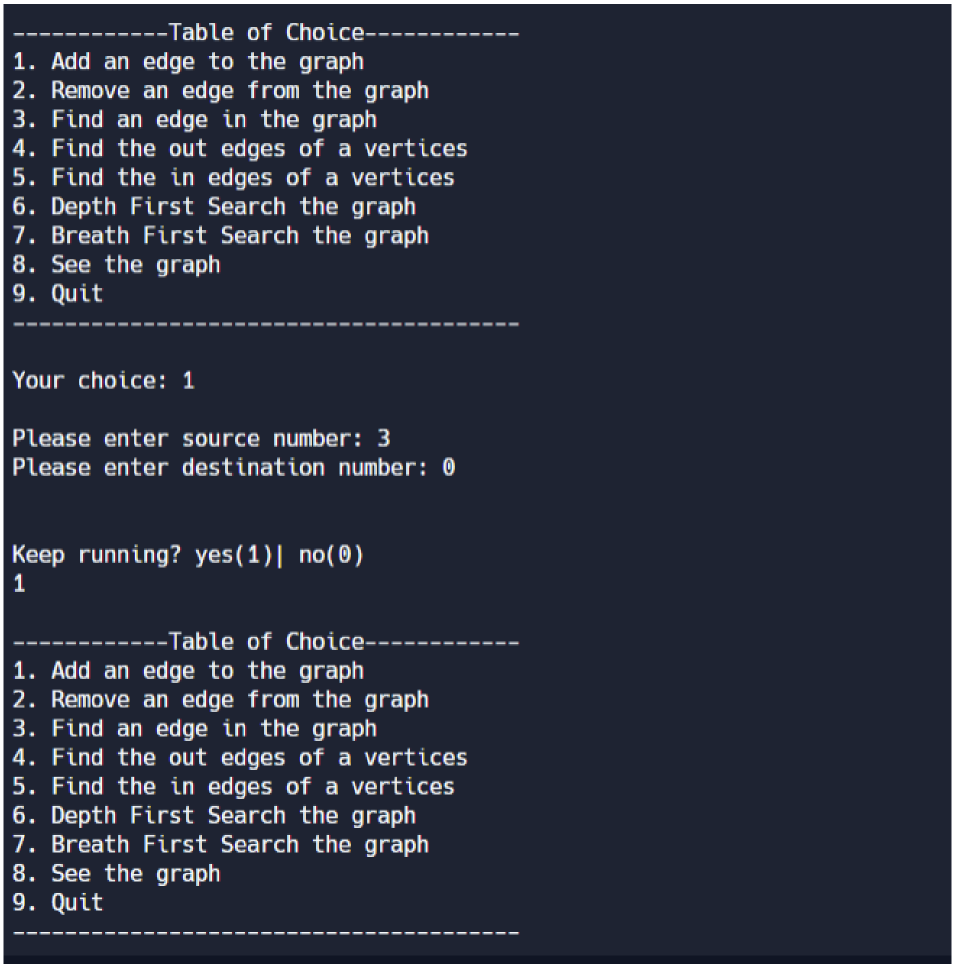
Task 3:



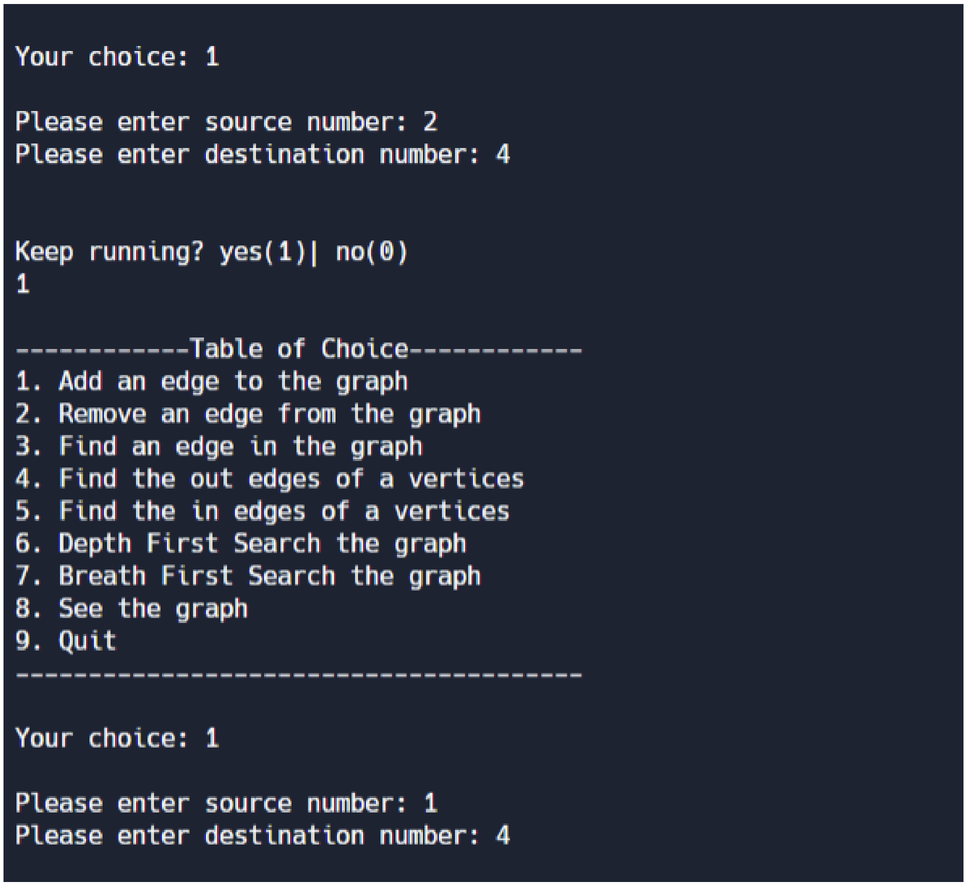
```
       Welcome to Lab 11!
Please eneter the number of vertices for the graph: 5

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 0
Please enter destination number: 2


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------
```



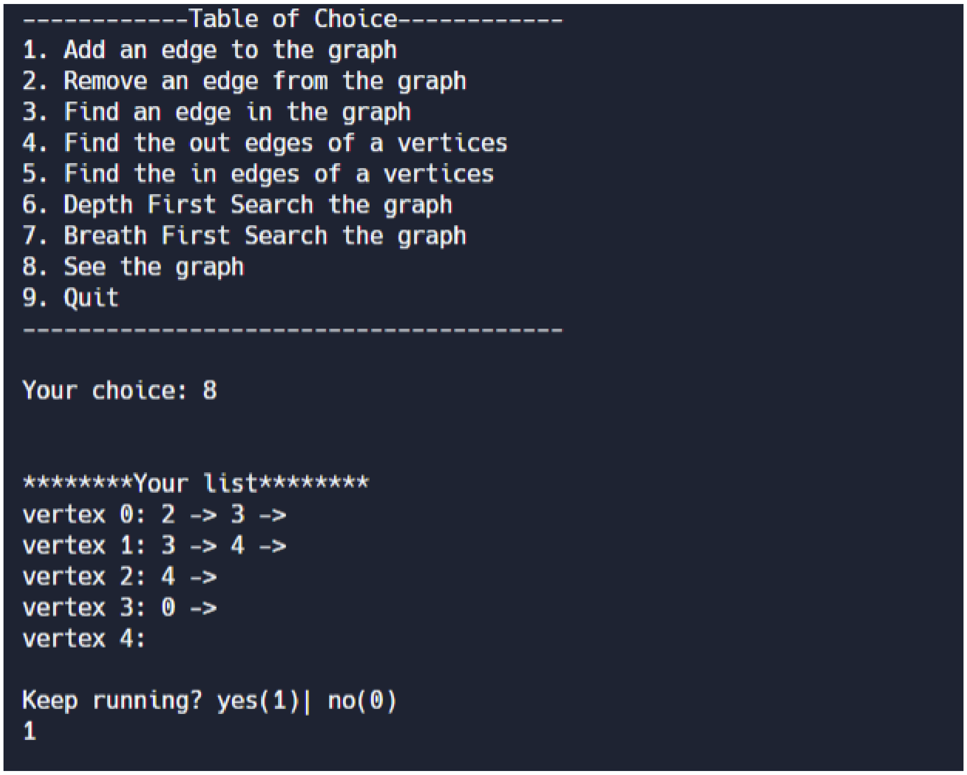
```
Your choice: 1

Please enter source number: 0
Please enter destination number: 3


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 1
Please enter destination number: 3


Keep running? yes(1)| no(0)
1
```



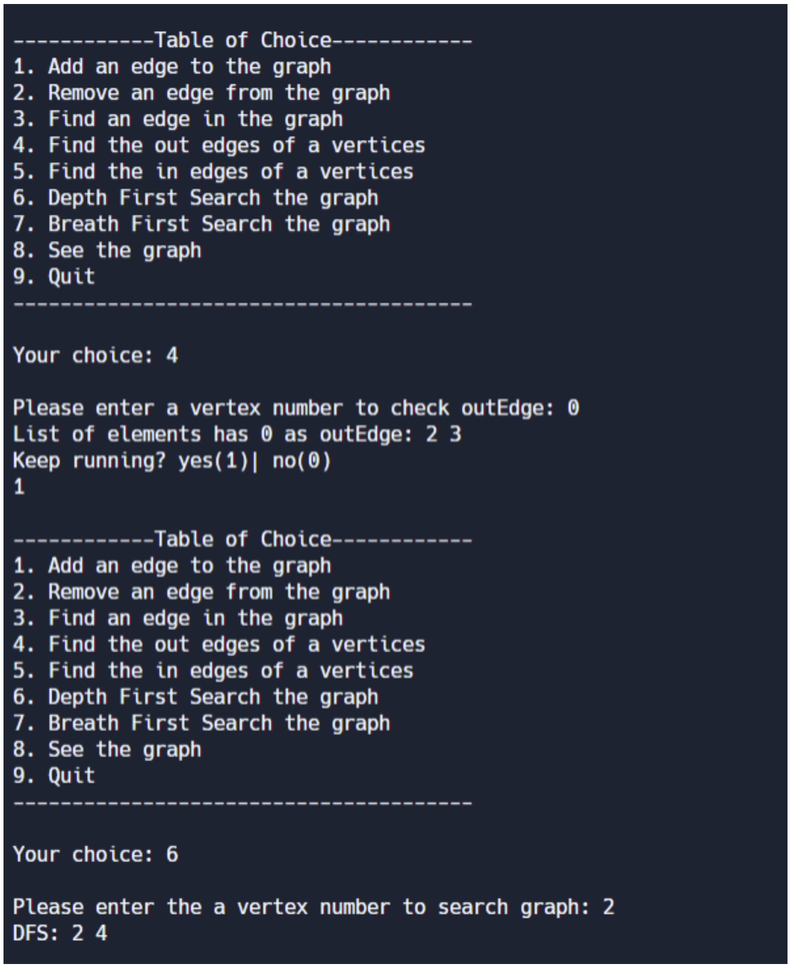
```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 3
Please enter destination number: 0


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------
```



```
Your choice: 1

Please enter source number: 2
Please enter destination number: 4


Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 1

Please enter source number: 1
Please enter destination number: 4
```

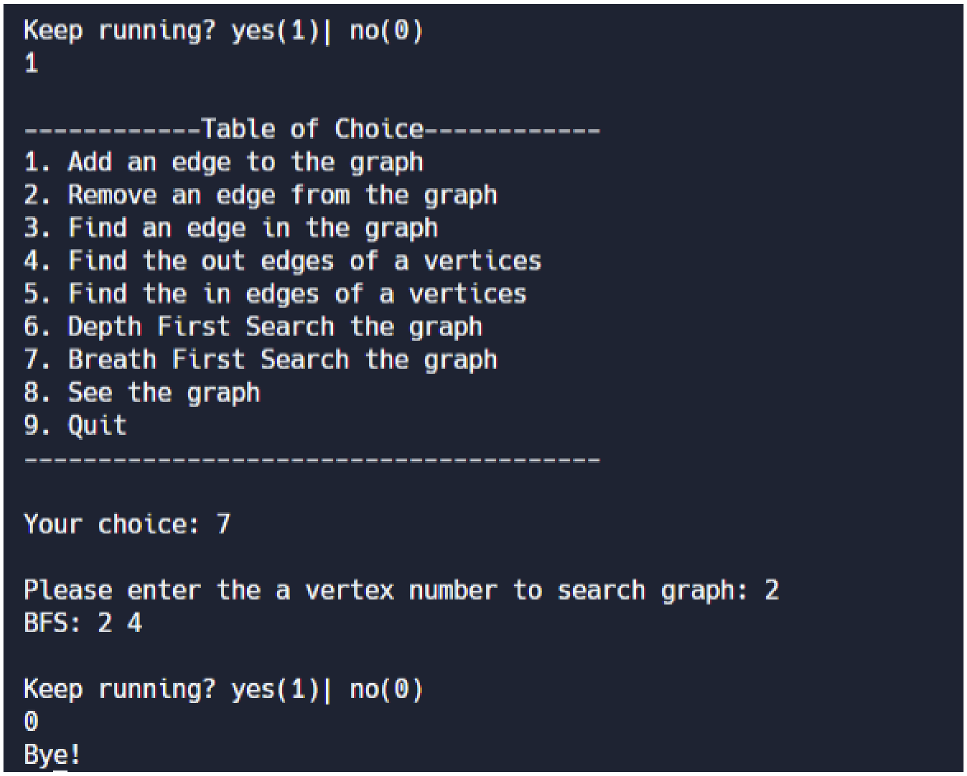


```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 8


********Your list********
vertex 0: 2 -> 3 ->
vertex 1: 3 -> 4 ->
vertex 2: 4 ->
vertex 3: 0 ->
vertex 4:

Keep running? yes(1)| no(0)
1
```



```
------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 4

Please enter a vertex number to check outEdge: 0
List of elements has 0 as outEdge: 2 3
Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 6

Please enter the a vertex number to search graph: 2
DFS: 2 4
```

Task 4:



```
Keep running? yes(1)| no(0)
1

------------Table of Choice------------
1. Add an edge to the graph
2. Remove an edge from the graph
3. Find an edge in the graph
4. Find the out edges of a vertices
5. Find the in edges of a vertices
6. Depth First Search the graph
7. Breath First Search the graph
8. See the graph
9. Quit
---------------------------------------

Your choice: 7

Please enter the a vertex number to search graph: 2
BFS: 2 4

Keep running? yes(1)| no(0)
0
Bye!
```

Task 5:

We used the standard STL library of List to implement both.

Depth First Search:

- We divided the vertex of the graph into visited and not visited, to avoid going into cycles
- We used the algorithm of stack structure because it is easy to follow, and build based on it.
- Implement by:
    - Start by putting the graph vertices on top of a stack
    - Take the top item out of stack and mark it visited
    - Then created a list of vertex's adjacent nodes, add those not visited on top of stack
    - Keep repeating steps 2 and 3 till the stack is empty.

Breadth First Search:

- We divided the vertex of the graph into visited and not visited, to avoid going into cycles
- We used the algorithm of queue structure because it is easy to follow, and build based on it.
- Implement by:
    - Putting any graph's vertices at the back of the queue
    - Take the front of the queue and add and mark it visited
    - Create a list of vertex's adjacent nodes, add those not visited to the back of the queue

- Keep repeating steps 2 and 3 till the queue is empty.

For memory, the DFS needed less code to implement and easier to build compared to the BFS. I would choose the DFS search since the BFS search would not work for some cases, such that the graph might have two different disconnect parts so if we want it to work, we need to cover every vertex, so the BFS works on every node.

Contributions

Jack Vo: graph and main

Haru Chu: clean up and testing

Nicholas Krouse: debug