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## Graph Solver Project Report

We were assigned problem number 11, which is find  $s$  where  $\text{is\_path}(s, A, B)$  and  $\text{color}(s, \text{Color}, t)$  and  $t > C$ .  $A, B, C$ , and  $\text{Color}$  are user inputs, and  $t$  is number of edges that has the color  $k$ . For our solver, we're finding all sets of edges that has a path from  $A$  to  $B$ , and the paths must satisfy the condition  $t > C$ .

In `main.py`, it asks for a csv file in the command argument, and then, asks user inputs. The input nodes must exist in the graph to output a path. Once the program obtains all the inputs, it creates a graph from `network` module that contains all nodes between every edge, their edge weight, and their edge color. Then, it is passed to `find_paths()`, which will output all possible paths into a `output.txt` file.

In `find_paths()`, it is a recursive function that starts with node  $A$ , and, using `networkx's neighbor()`, it will find every node that is connected to  $A$ . When it finds  $B$ , it will check `is_path()` and `color()` and determine whether the path will be outputted to `output.txt`. Any dead end or paths that don't satisfy the conditions will not be outputted. Figure 1 shows when the user's inputs are  $A=1, B=6, C=1, k=\text{green}$ , and `output.txt`. Figure 2 shows the `graph.csv` file which the program runs from.

```
1 path_0:
2 1, 2
3 2, 7
4 7, 3
5 3, 4
6 4, 6
7 path_1:
8 1, 2
9 2, 7
10 7, 6
11 path_2:
12 1, 3
13 3, 7
14 7, 6
15
```

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

Microsoft Windows [Version 10.0.18362.476]  
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C:\Users\hayde\Documents\GitHub\EECS118\GraphProblemSolver>python main.py graph.csv  
Input A:  
1  
Input B:  
6  
Input C:  
1  
Input Color:  
green  
1 6 1 green  
color() is True  
is\_path() is True  
color() is True  
is\_path() is True  
color() is True  
is\_path() is True

Figure 1

```
1,2,0.5,green
1,3,0.9,green
1,4,1.0,black
2,7,0.7,green
7,3,0.5,green
3,4,0.1,blue
4,6,0.2,white
7,6,0.6,white
```

Figure 2

Above is one of the test cases. Rest of the test cases are shown below:

Test case 2 using the same graph from Figure2:

```
Input A:
4
Input B:
1
Input C:
2
Input Color:
black
4 1 2 black
```

From the inputs, the program didn't output anything because there isn't a path that satisfy  $t > C$ , where  $t=1$  and  $C=2$ .

Test case 3 using the same graph from Figure 2:

```
1 path_0:
2 7, 6
3 6, 4
4 4, 1
5

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

C:\Users\hayde\Documents\GitHub\EECS118\GraphProblemSolver>python main.py graph.csv
Input A:
7
Input B:
1
Input C:
0
Input Color:
white
7 1 0 white
color() is True
is_path() is True
```

From the inputs, there exist only one path that satisfies the condition from node 7 to 1.

```
0,7,5,green
1,17,5,green
2,3,5,green
2,6,5,green
2,18,5,green
2,19,5,green
4,16,5,green
5,14,5,green
5,16,5,green
5,12,5,green
7,10,5,green
7,13,5,green
7,14,5,green
8,15,7,green
8,12,7,green
9,11,7,green
11,19,7,green
12,17,7,green
17,19,7,green
```

Figure 3

Test case 4 using graph from Figure 3:

```
C:\Users\hayde\Documents\GitHub\EECS118\GraphProblemSolver>python main.py g3.csv
Input A:
2
Input B:
17
Input C:
5
Input Color:
green
2 17 5 green
```

The program didn't output anything because there no such path.

Test case 5 using graph from Figure 3:

```
1 path_0:
2 17, 12
3 12, 5
4 5, 16
5

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL

C:\Users\hayde\Documents\GitHub\EECS118\GraphProblemSolver>python main.py g3.csv
Input A:
17
Input B:
16
Input C:
2
Input Color:
green
17 16 2 green
color() is True
is_path() is True
```

The program found a path that satisfies the conditions.