CSCE 5580: Computer Networks

Programming Assignment 4

Due: 11:59 PM on Wednesday, April 29, 2020

PROGRAM DESCRIPTION:

In this project, you will write a complete C program to implement the OSPF link-state (LS) algorithm for a given set of nodes identified by a lower-case letter ($a - z$). The output of the program will be the shortest path cost and path taken for each node, when given a source node.

As an example, consider the following abstract model of a computer network:
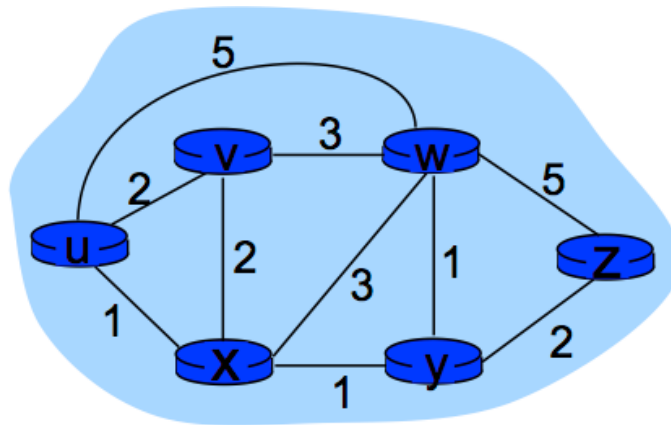
After running the link-state algorithm on this network, we have the following results:

Step	N'	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)	D(z),p(z)
0	u	2,u	5,u	1,u	∞	∞
1	ux	2,u	4,x		2,x	∞
2	uxy	2,u	3,y			4,y
3	uxyv		3,y			4,y
4	uxyvw					4,y
5	uxyvwz					

This network can be represented by the following file containing the cost matrix for each node, u through z, where a cost of -1 indicates that no direct path is available. The values for u are given on the first row, while the values for z are on the last row.

```
 0   2   5   1  -1  -1
 2   0   3   2  -1  -1
 5   3   0   3   1   5
 1   2   3   0   1  -1
-1  -1   1   1   0   2
-1  -1   5  -1   2   0
```

In the program, you will prompt for the number of routers and then read in a file containing values for an *n x n* cost matrix, where *n* is the number of routers entered by the user, such as the one given above.

Optionally, you may ask the user to enter the character representation of the first node, such as *u* in the example given above so that your node representation is schematically correct.

Finally you will prompt the user to enter the source router from which to calculate the shortest path cost and path taken from the source node to each node in the graph in the correct order.

Your code should handle all errors appropriately, such as printing an error message and/or terminating the program if the file for the cost matrix does not exist, for example.

SAMPLE OUTPUT (user input shown in **bold**)**:**

```
$ more fig5_3
0 2 5 1 -1 -1
2 0 3 2 -1 -1
5 3 0 3 1 5
1 2 3 0 1 -1
-1 -1 1 1 0 2
-1 -1 5 -1 2 0
$ ./a.out
OSPF Link-State (LS) Routing:
----------------------------
Enter the number of routers: 6
Enter filename with cost matrix values: fig5_3
Enter character representation of first node: u
Enter the source router: u
u ==> u:
path cost : 0
path taken: u
u ==> v:
path cost : 2
path taken: u --> v
u ==> w:
path cost : 3
path taken: u --> x --> y --> w
u ==> x:
path cost : 1
path taken: u --> x
u ==> y:
path cost : 2
path taken: u --> x --> y
u ==> z:
path cost : 4
path taken: u --> x --> y --> z
$ ./a.out
OSPF Link-State (LS) Routing:
----------------------------
```

```
Enter the number of routers: 6
Enter filename with cost matrix values: fig5_3
Enter character representation of first node: u
Enter the source router: v
v ==> u:
path cost : 2
path taken: v --> u
v ==> v:
path cost : 0
path taken: v
v ==> w:
path cost : 3
path taken: v --> w
v ==> x:
path cost : 2
path taken: v --> x
v ==> y:
path cost : 3
path taken: v --> x --> y
v ==> z:
path cost : 5
path taken: v --> x --> y --> z
$ ./a.out
OSPF Link-State (LS) Routing:
----------------------------
Enter the number of routers: 6
Enter filename with cost matrix values: notexist
error: unable to open file: notexist
```

REQUIREMENTS:

- Your code should be well documented in terms of comments. For example, good comments in general consist of a header (with your name, course section, date, and brief description), comments for each variable, and commented blocks of code.

- Your C program file should be named "`prog4.c`", without the quotes.

- Your program will be graded based largely on whether it works correctly on the CSE machines (e.g., cse01, cse02, ..., cse06), so you should make sure that your program compiles and runs on a CSE machine.

- Please pay attention to the **SAMPLE OUTPUT** for how this program is expected to work. If you have any questions about this, please contact your instructor or TA assigned to this course to ensure you understand these directions.

- This is an individual programming assignment that must be the sole work of the individual student. Any instance of academic dishonesty will result in a grade of "F" for the course, along with a report filed into the Academic Integrity Database.

SUBMISSION:

- You will electronically submit your source code file, `prog4.c`, to the **Program 4** dropbox in Canvas by the due date.