

CS542-04 Project Report
Link State Routing Simulator

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Abstract:-

The goal of this project is to implement Link State Routing Protocol using Dijkstra's Algorithm. The algorithm is mainly used to find shortest path from source to destination.

Introduction:-

The main function of the routing protocol is to share the information among the nodes of the network topology through which the nodes can select the best path for communication within the network. It also specifies the way in which routers communicate with each other. The routing protocol broadcasts the routing table to the router's adjacent nodes in periodic manner.

Objective:-

The main objective of the project is to implement the link state routing protocol using Dijkstra's algorithm. Below are the functionalities provided by the project:-

- Read the text file which contains connection matrix from the user.
- Create a connection table which shows next adjacent node through which source node will communicate with destination node.
- Give the shortest path from source node to the destination node along with the cost
- If any router is deleted, the topology is modified, and results are obtained accordingly.
- Provides the best router for broadcast.

Link State Routing Protocol:-

- The main concept of link state routing protocol is to build a graph which displays the connectivity amongst the nodes in the network.
- The nodes calculate the path from itself to every possible destination node in the topology individually.
- The node's routing table is generated by selecting the tree with shortest path.
- In Link State Routing protocol, the nodes send periodic updates to its neighboring node or the adjacent node within the network topology.
- The main principle of Link State Routing Protocol is that all the nodes or routers present in the network must have identical copies of the network topology.

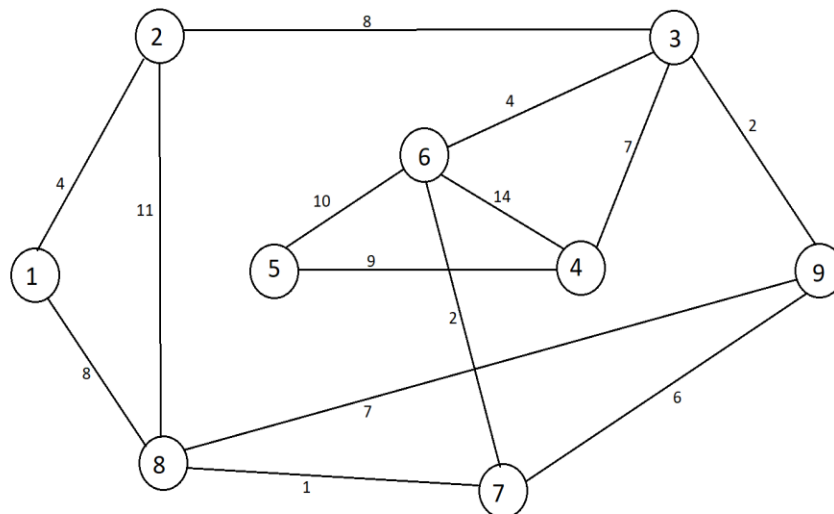
Dijkstra's Algorithm: -

Dijkstra's Algorithm is used to find shortest path from source router to the destination router.

The steps for Dijkstra's Algorithm are as follows: -

1. Initially, all the nodes are set to infinite as they are undiscovered except for the initial node which is set to zero.
2. Initial node is current node and rest of the nodes are unvisited nodes. Set for unvisited nodes is made.
3. Tentative distance is calculated from current node to the unvisited nodes; compare it with previously assigned distance, the smaller distance is assigned to the path.
4. The visited node won't be visited again, and the current node is also removed from unvisited set.
5. If the smallest distance from current node to desired destination node is found, then goal is accomplished, and algorithm ends.
6. Otherwise, the unvisited node is selected with smallest tentative distance and step 3 to step 6 are repeated.

Network Topology of Test File:



Steps to Execute:

OS used: **Windows 10**

Language used for coding: **Java**

Environment (IDE) used: **Eclipse**

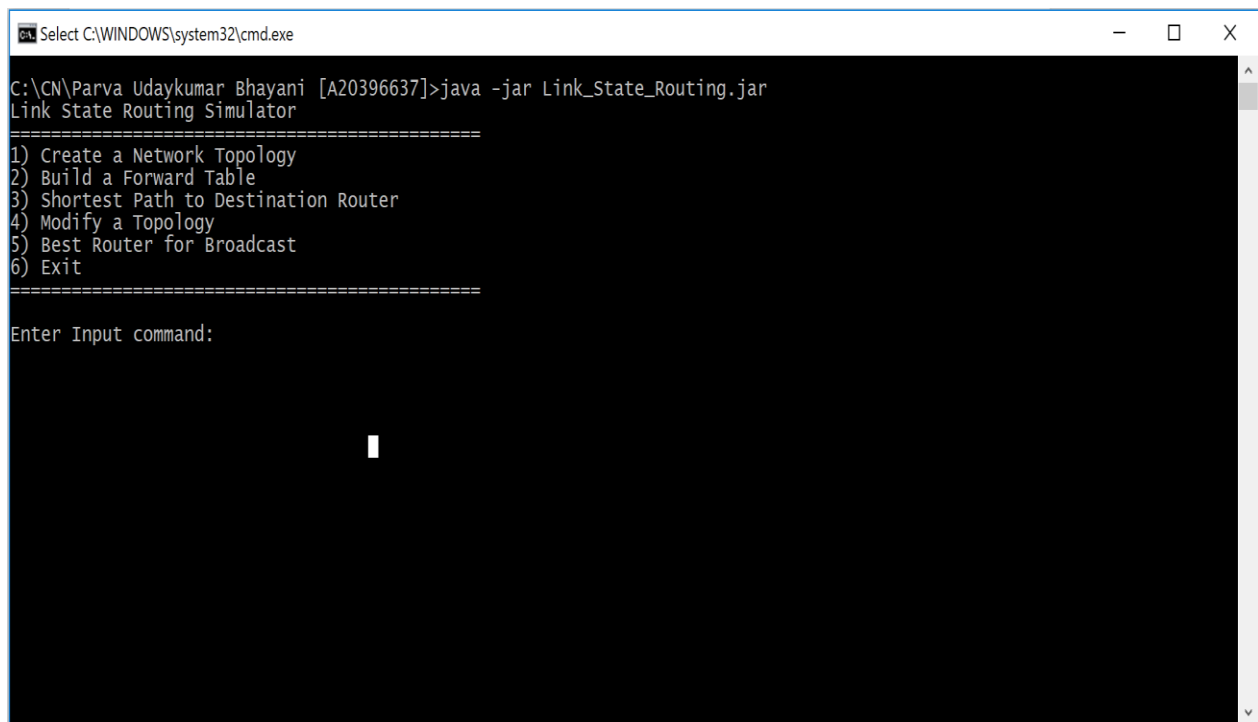
Extract the file named "**CS54204_2017F_Project_09_Bhayani_Parva Udaykumar.zip**"

Run Batch file named "Run jar"

Or

Open command prompt , go to the directory where we extract the folder and type

java -jar Link_State_Routing.jar



```
Select C:\WINDOWS\system32\cmd.exe

C:\CN\Parva Udaykumar Bhayani [A20396637]>java -jar Link_State_Routing.jar
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
█
```

Design:

Using Command 1: Input the Network Topology File which contains Matrix (i.e : test1.txt)

```

C:\WINDOWS\system32\cmd.exe
Enter Input command:
1
Input Network File:
test1.txt

no of rows: 9 no of columns: 9

Network Topology is as follow
=====
0 4 -1 -1 -1 -1 -1 8 -1
4 0 8 -1 -1 -1 -1 11 -1
-1 8 0 7 -1 4 -1 -1 2
-1 -1 7 0 9 14 -1 -1 -1
-1 -1 -1 9 0 10 -1 -1 -1
-1 -1 4 14 10 0 2 -1 -1
-1 -1 -1 -1 -1 2 0 1 6
8 11 -1 -1 -1 -1 1 0 7
-1 -1 2 -1 -1 -1 6 7 0
=====

Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====

```

Using Command 2 : we will display forward table of the entered Source router (changed as per need). It will show that to which next adjacent router the packet has to be send from the source router for it to reach at destination with the lowest cost.

```

C:\WINDOWS\system32\cmd.exe
Enter Input command:
2
Please Enter Source Router :
8
Router 8 Connection Table
Destination
Router      Interface
=====
1           1
2           2
3           7
4           7
5           7
6           7
7           7
8           -
9           9
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:

```

Using Command 3: It will display the route to destination from source router. (Source to destination with intermediate node from which the packets will travel in the same manner)

```

C:\WINDOWS\system32\cmd.exe
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
3
Select a Destination Router:
4
The Shortest Path from Router 8 to 4 is 8->7->6->3->4
The Total Cost is 14
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:

```

Using Command 4: suppose due to some reasons , the router has been compromised or shut down , than what will be the new path to destination. Source or Destination may also be dead. (Delete the Router. Update the topology. Show New Path)

```

C:\WINDOWS\system32\cmd.exe
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
4
Select a Router to be removed:
7
Review Topology Matrix:
0 4 -1 -1 -1 -1 -1 8 -1
4 0 8 -1 -1 -1 -1 11 -1
-1 8 0 7 -1 4 -1 -1 2
-1 -1 7 0 9 14 -1 -1 -1
-1 -1 -1 9 0 10 -1 -1 -1
-1 -1 4 14 10 0 -1 -1 -1
-1 -1 -1 -1 -1 -1 0 -1 -1
8 11 -1 -1 -1 -1 -1 0 7
-1 -1 2 -1 -1 -1 -1 7 0
After Deleting Router 7
New Forward table and Path from source to destination is as follows:
Router 8 Connection Table
Destination
Router      Interface
=====
1            1
2            2

```

```

C:\WINDOWS\system32\cmd.exe
Review Topology Matrix:
0 4 -1 -1 -1 -1 -1 8 -1
4 0 8 -1 -1 -1 -1 11 -1
-1 8 0 7 -1 4 -1 -1 2
-1 -1 7 0 9 14 -1 -1 -1
-1 -1 -1 9 0 10 -1 -1 -1
-1 -1 4 14 10 0 -1 -1 -1
-1 -1 -1 -1 -1 -1 0 -1 -1
8 11 -1 -1 -1 -1 -1 0 7
-1 -1 2 -1 -1 -1 -1 7 0
After Deleting Router 7
New Forward table and Path from source to destination is as follows:
Router 8 Connection Table
Destination
Router      Interface
=====
1            1
2            2
3            9
4            9
5            9
6            9
7            -
8            -
9            9
The Shortest Path from Router 8 to 4 is 8->9->3->4
The Total Cost is 16
Link State Routing Simulator
=====
1) Create a Network Topology

```

Using Command 5: Display the Best Router in the Network from which all the other router's cost is minimal compare to other routers.

```

C:\WINDOWS\system32\cmd.exe
6) Exit
=====
Enter Input command:
5
Router 3 is best for broadcast
Destination      Distance from
Router           Router 3
=====
1                12
2                8
3                0
4                7
5                14
6                4
7                0
8                9
9                2
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:

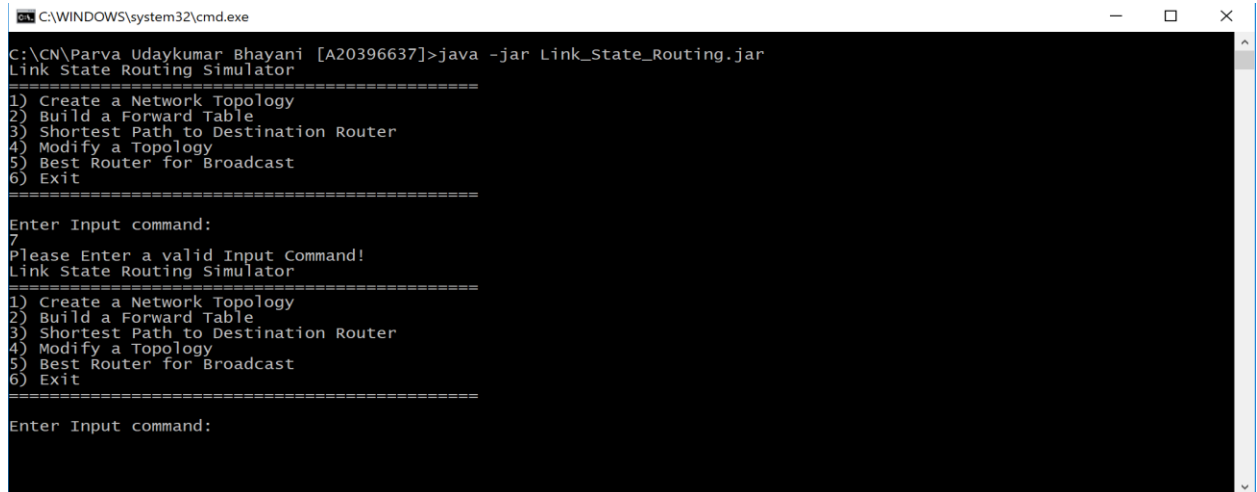
```

Using Command 6: The executable file or command will close itself.

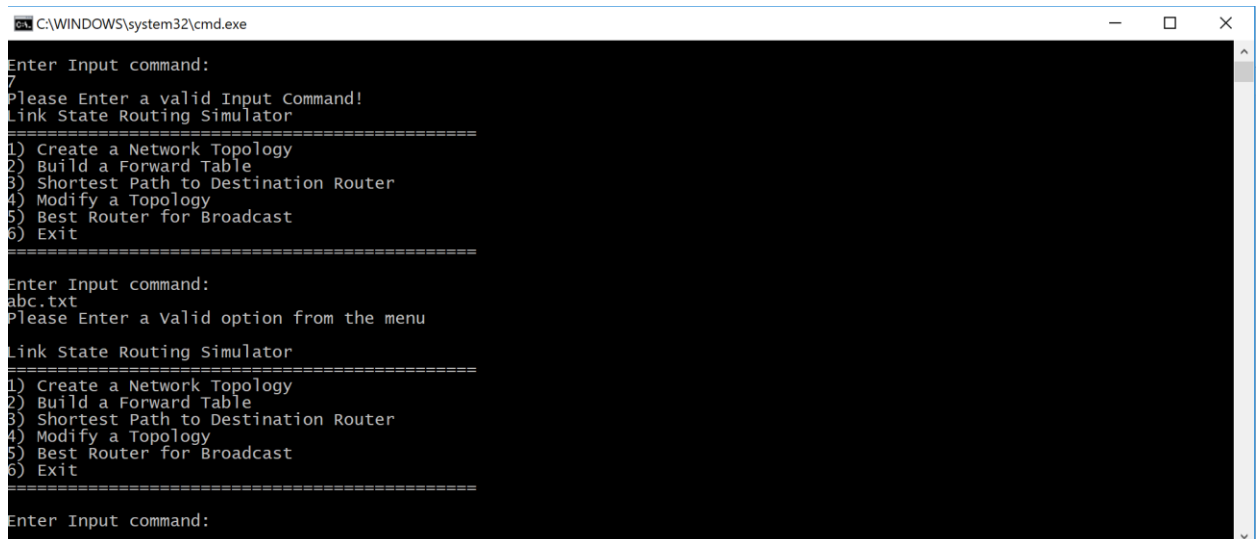
Error Handling:

While Testing the program, I went through various errors that can be possible and handled those errors.

1. What if someone while using the application instead of option available enters that is 1 to 6. Enters 7 or above. What if someone enters characters instead of Integer, What if someone a string (Enters the Topology file instead of Integers).



```
C:\WINDOWS\system32\cmd.exe
C:\CN\Parva Udaykumar Bhayani [A20396637]>java -jar Link_State_Routing.jar
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
7
Please Enter a valid Input Command!
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
```



```
C:\WINDOWS\system32\cmd.exe
Enter Input command:
7
Please Enter a valid Input Command!
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
abc.txt
Please Enter a Valid option from the menu
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
```

2. What if someone enters the file which is not available.

```

C:\WINDOWS\system32\cmd.exe
Please Enter a Valid option from the menu
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
1
Input Network File:
xyz.txt
Please Enter a valid text file with Extension
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:

```

3. What if Someone Enters the matrix file whose no of Rows are not same as no of Columns

```

C:\WINDOWS\system32\cmd.exe
xyz.txt
Please Enter a valid text file with Extension
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
1
Input Network File:
test2.txt
Please Enter valid Network Topology
Link State Routing Simulator
=====
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:

```

4. What if someone Enters the file whose Matrix diagonal are not zero. As router to itself cost is zero.

```

C:\WINDOWS\system32\cmd.exe
1) Create a Network Topology
2) Build a Forward Table
3) Shortest Path to Destination Router
4) Modify a Topology
5) Best Router for Broadcast
6) Exit
=====
Enter Input command:
1
Input Network File:
test3.txt
no of rows: 9 no of columns: 9
Network Topology is as follow
=====
5 4 -1 -1 -1 -1 -1 8 -1
4 0 8 -1 -1 -1 -1 11 -1
-1 8 0 7 -1 4 -1 -1 2
-1 -1 7 0 9 14 -1 -1 -1
-1 -1 -1 9 0 10 -1 -1 -1
-1 -1 4 14 10 0 2 -1 -1
-1 -1 -1 -1 -1 2 0 1 6
8 11 -1 -1 -1 -1 1 0 7
-1 -1 2 -1 -1 -1 6 7 0
=====
Enter a valid Topology whose diagonal should be zero

```

Conclusion:

The implemented program for Link State Routing Protocol works for any network topology regardless of the size of the network. Node itself doesn't know from which path the packet will be received to Destination as it has only partial information (only of the adjacent node). Given the valid Network Topology File,

- 1) No. of rows = No. of columns
- 2) Diagonal Should be zero.
- 3) Router to other router cost and vice versa cost should be same

It will calculate Shortest Path from Source to Destination. Also Considering real world Scenario, Router may be dead or removed, the program can handle the situation, will create the new Network forwarding table and print the new Source to Destination path. Also, it determine the best broadcast router.