Implementation of Routing Information Protocol using C

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1 Background

Routing is the technique by which a node (host or gateway), when presented with a packet addressed to some node, decides where to send the packet. If that destination is on one of the networks that are directly connected to the host or gateway, the datagram is sent directly. The "Hardware" or Ethernet Address is discovered using the ARP Protocol. If the destination is not directly reachable, the host or gateway attempts to send the datagram to a gateway that is nearer to the destination - this is the essence of routing.
There are two aspects to routing - a routing algorithm that uses information about the net- work topology and uses a distributed algorithm to determine the path that a packet should take to reach the destination. The routing protocol is a mechanism by which the network status information is exchanged by the nodes in the network. Routing algorithm usually compute the shortest path to the destination on a graph representation of the network.
RIP (Routing Information Protocol) is an interior gateway protocol defined by RFC 1058 and used to update routes dynamically within an autonomous system. RIP works best for small sized networks using reasonable homogeneous technology. RIP belongs to a class of algorithms known as distance vector algorithm that essentially uses a distributed version of Bellman-Ford algorithm that each node executes to determine the lease cost to each destination in the network and also the next node on this optimal path.
Each entry (host or gateway) maintains a routing database with one entry for every possible destination in the network. The following minimum information should be maintained for each destination

1. IP address of the host or network
2. First gateway along the route to the destination
3. The port or the physical interface used to reach the first router or gateway to the best path
4. Cost to reach the destination
5. Last update time

2 The Assignment Task

1. Write a program to simulate RIP on a linux PC. You should run multiple instances of same program with different port binding, to exchange RIP update messages. You will be provided with a network topology, in the form of router interconnections. Folders named R1, R2, · · · , R10 are provided, which have:
   - conn.dat - This contains the Port numbers of the routers to which each router is directly connected (one hop away). This will contain entries in the form of: <port number> <weight of the link>, where <weight of the link> can be any integer from 1 - 10, indicating the cost of using that link.
2. The update period (default 30 seconds) should be programmable.
3. Port number of each router would be 8000 + router number. (Eg: for R8 it is 8008)
4. Update RIP.txt file every update period for each Router, in Rx folder where x represents router number. It should contain cost to each router (Note: choose "infinity" reasonably)
5. After convergence of all router metrics, write the converged costs to convergedMetrics.txt in the following format (separation using space and semicolon):
   R1 <cost to R1>;<cost to R2>; ... ;<cost to R10>;
   R2 <cost to R1>;<cost to R2>; ... ;<cost to R10>;
   ..
   R10 <cost to R1>;<cost to R2>; ... ;<cost to R10>;

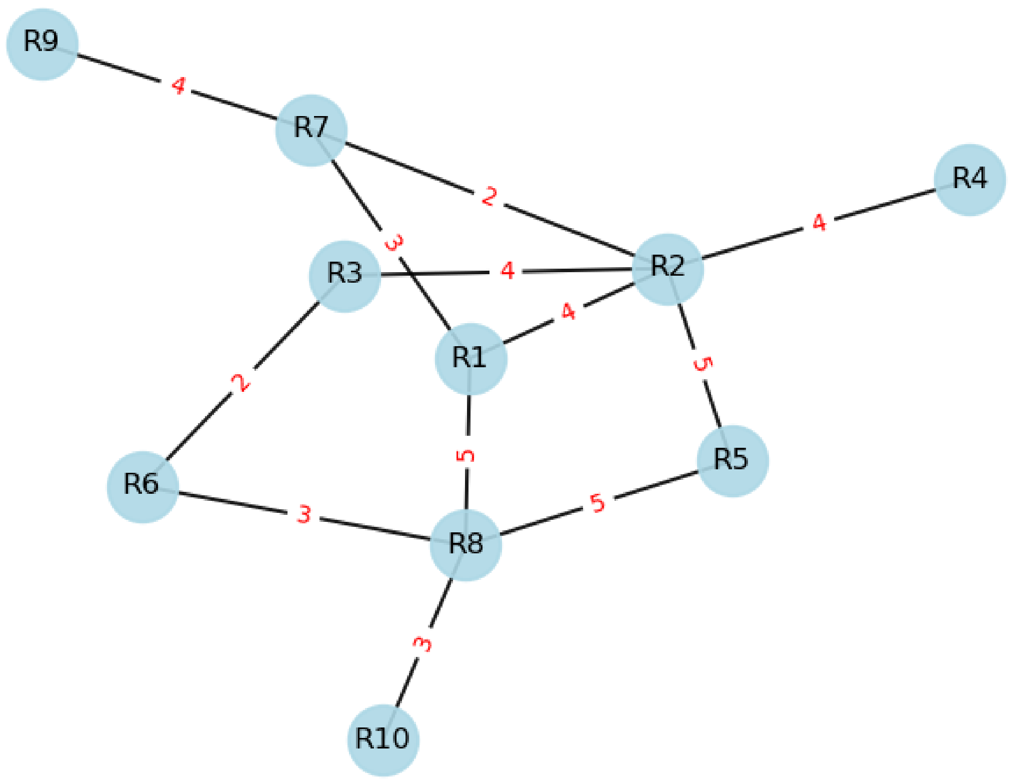
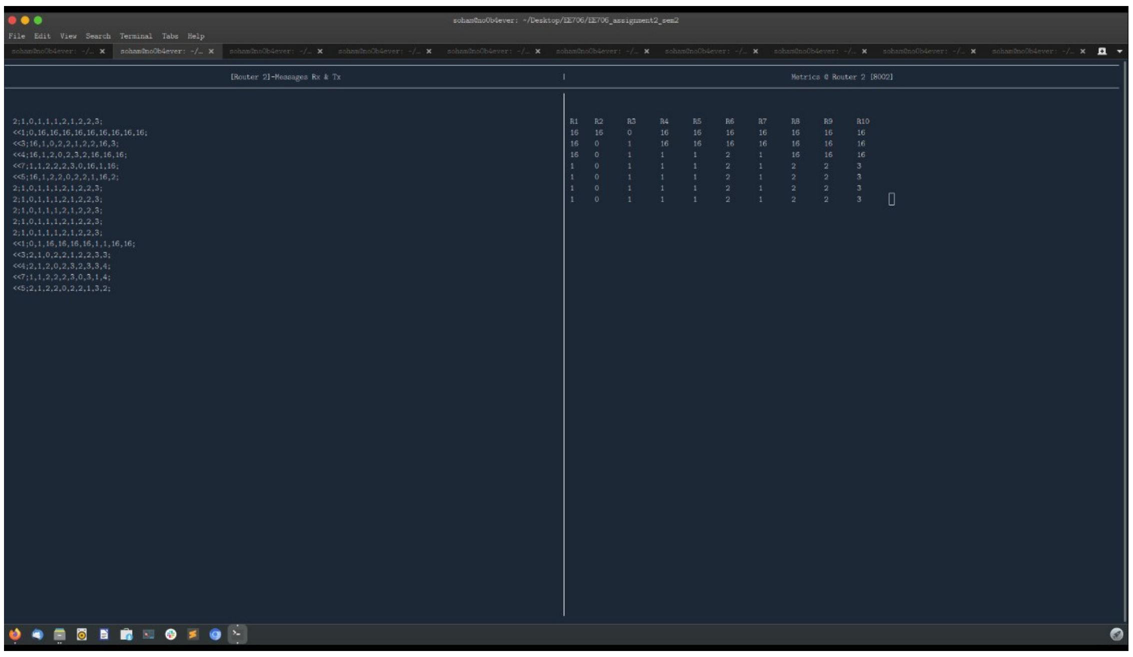


Figure 1: Example of a network topology

3 Code Outputs

In the screenshots of the code output we can see on the left portion, the message received by a particular router from all the router connected to it which contains the cost of the links. The right side of the screen displays the cost of the links for the particular router at the present time instance. The messages are sent periodically based on the time parameter set while executing the code (default value is 10 seconds). We can remove or add nodes dynamically and the cost of the links will get updated accordingly. However the maximum number of nodes present in the network is fixed when we write the command to execute the code.


soham@no0b4ever: ~/Desktop/EE706/EE706_assignment2_sem2
File Edit View Search Terminal Tabs Help

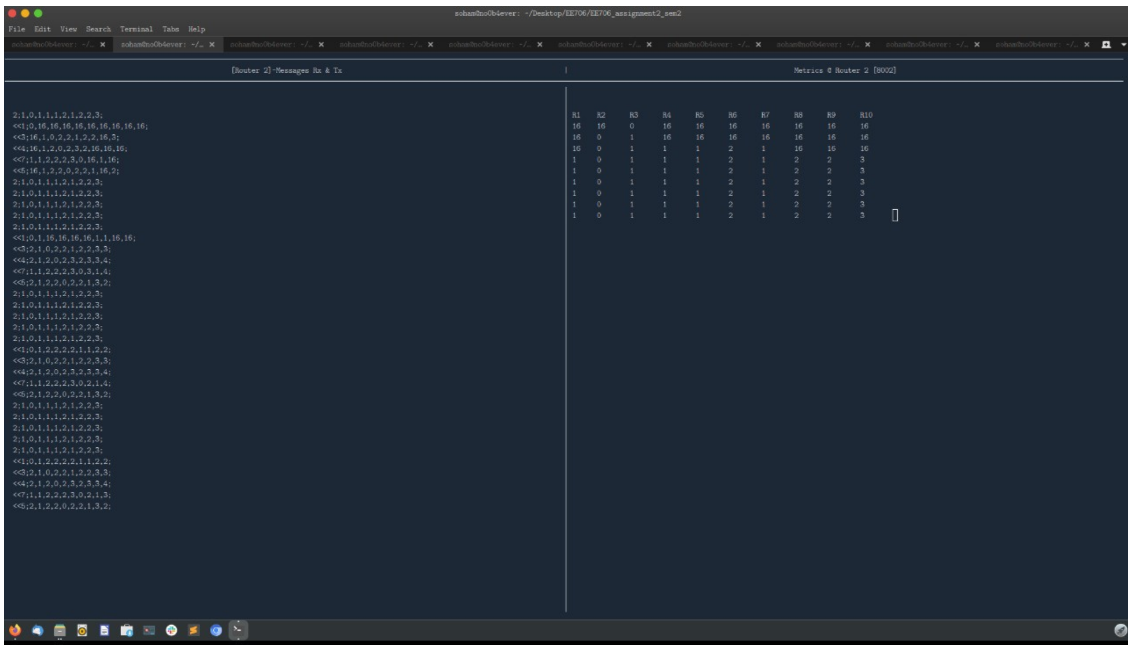
```
[Router 2]-Messages Rx & Tx

2;1,0,1,1,1,2,1,2,2,3;
<<1;0,16,16,16,16,16,16,16,16,16;
<<3;16,1,0,2,2,1,2,2,16,3;
<<4;16,1,2,0,2,3,2,16,16,16;
<<7;1,1,2,2,2,3,0,16,1,16;
<<5;16,1,2,2,0,2,2,1,16,2;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
<<1;0,1,16,16,16,16,1,1,16,16;
<<3;2,1,0,2,2,1,2,2,3,3;
<<4;2,1,2,0,2,3,2,3,3,4;
<<7;1,1,2,2,2,3,0,3,1,4;
<<5;2,1,2,2,0,2,2,1,3,2;
```

```
Metrics @ Router 2 [8002]

R1   R2    R3    R4    R5    R6    R7    R8    R9    R10
16   16    0     16    16    16    16    16    16    16
16   0     1     16    16    16    16    16    16    16
16   0     1     1     1     2     1     16    16    16
1    0     1     1     1     2     1     2     2     3
1    0     1     1     1     2     1     2     2     3
1    0     1     1     1     2     1     2     2     3
1    0     1     1     1     2     1     2     2     3
```

Figure 2: Screenshot 1



```
soham@no0b4ever: ~/Desktop/EE706/EE706_assignment2_sem2

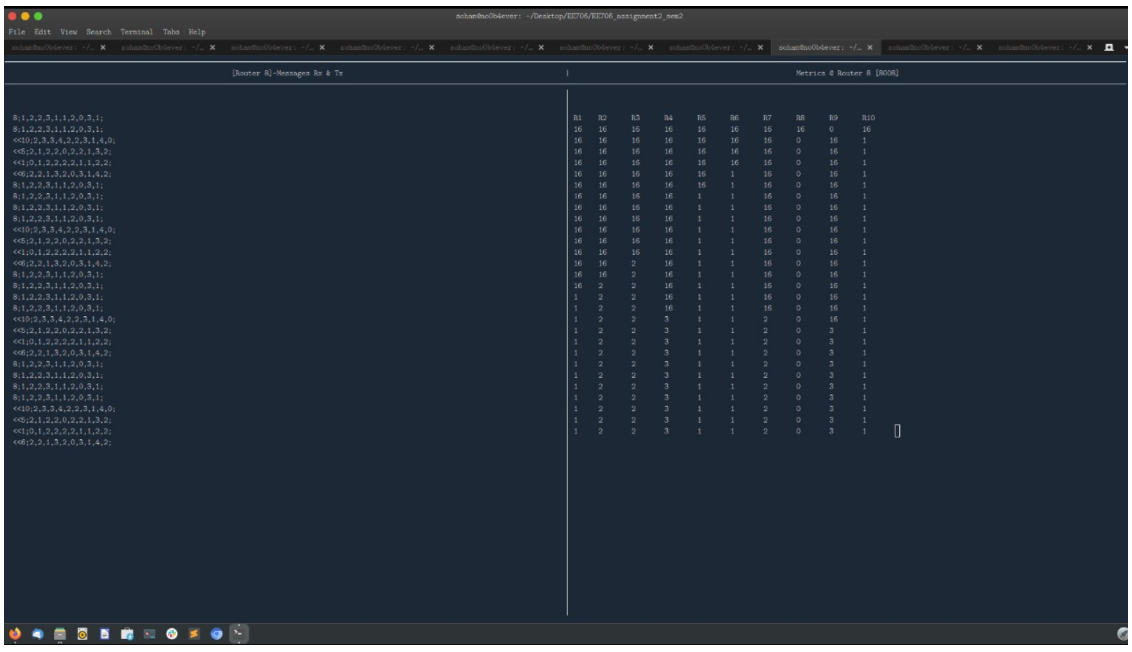
[Router 2]-Messages Rx & Tx

2;1,0,1,1,1,2,1,2,2,3;
<<1;0,16,16,16,16,16,16,16,16,16;
<<3;16,1,0,2,2,1,2,2,16,3;
<<4;16,1,2,0,2,3,2,16,16,16;
<<7;1,1,2,2,2,3,0,16,1,16;
<<5;16,1,2,2,0,2,2,1,16,2;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
<<1;0,1,16,16,16,16,1,1,16,16;
<<3;2,1,0,2,2,1,2,2,3,3;
<<4;2,1,2,0,2,3,2,3,3,4;
<<7;1,1,2,2,2,3,0,3,1,4;
<<5;2,1,2,2,0,2,2,1,3,2;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
<<1;0,1,2,2,2,2,1,1,2,2;
<<3;2,1,0,2,2,1,2,2,3,3;
<<4;2,1,2,0,2,3,2,3,3,4;
<<7;1,1,2,2,2,3,0,2,1,4;
<<5;2,1,2,2,0,2,2,1,3,2;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
2;1,0,1,1,1,2,1,2,2,3;
<<1;0,1,2,2,2,2,1,1,2,2;
<<3;2,1,0,2,2,1,2,2,3,3;
<<4;2,1,2,0,2,3,2,3,3,4;
<<7;1,1,2,2,2,3,0,2,1,3;
<<5;2,1,2,2,0,2,2,1,3,2;
```

```
Metrics @ Router 2 [8002]

R1   R2   R3   R4   R5   R6   R7   R8   R9   R10
16   16   0    16   16   16   16   16   16   16
16   0    1    16   16   16   16   16   16   16
16   0    1    1    1    2    1    16   16   16
1    0    1    1    1    2    1    2    2    3
1    0    1    1    1    2    1    2    2    3
1    0    1    1    1    2    1    2    2    3
1    0    1    1    1    2    1    2    2    3
1    0    1    1    1    2    1    2    2    3
1    0    1    1    1    2    1    2    2    3
```

Figure 3: Screenshot 2



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soham@no0b4ever: ~/Desktop/EE706/EE706_assignment2_sem2

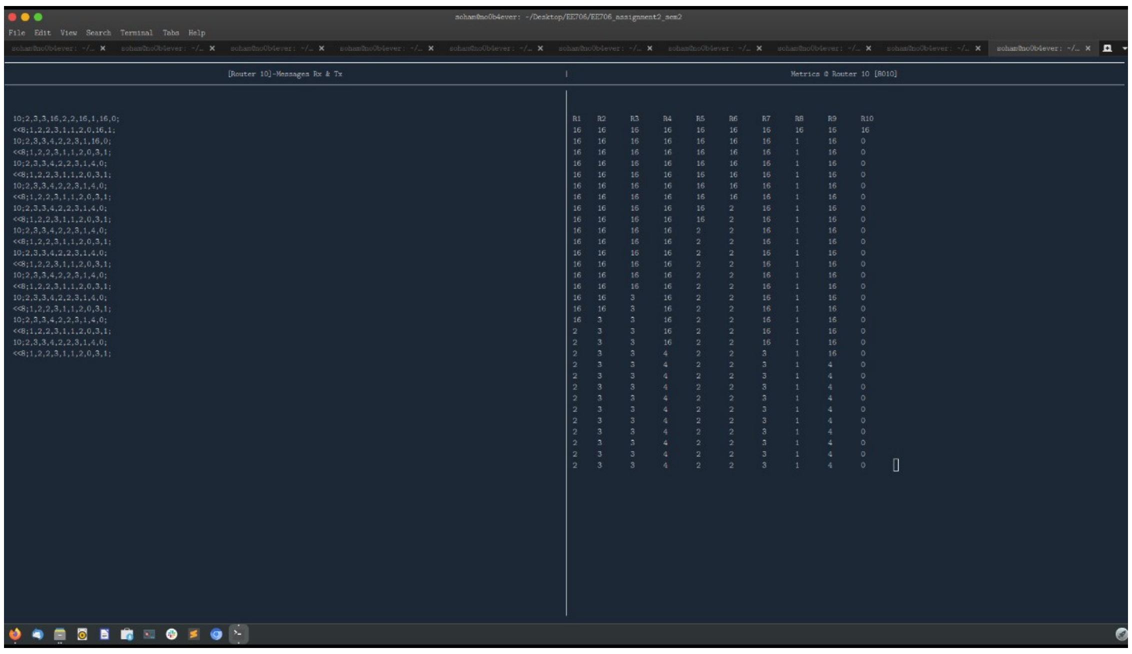
[Router 8]-Messages Rx & Tx

8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
<<10;2,3,3,4,2,2,3,1,4,0;
<<5;2,1,2,2,0,2,2,1,3,2;
<<1;0,1,2,2,2,2,1,1,2,2;
<<6;2,2,1,3,2,0,3,1,4,2;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
<<10;2,3,3,4,2,2,3,1,4,0;
<<5;2,1,2,2,0,2,2,1,3,2;
<<1;0,1,2,2,2,2,1,1,2,2;
<<6;2,2,1,3,2,0,3,1,4,2;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
<<10;2,3,3,4,2,2,3,1,4,0;
<<5;2,1,2,2,0,2,2,1,3,2;
<<1;0,1,2,2,2,2,1,1,2,2;
<<6;2,2,1,3,2,0,3,1,4,2;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
8;1,2,2,3,1,1,2,0,3,1;
<<10;2,3,3,4,2,2,3,1,4,0;
<<5;2,1,2,2,0,2,2,1,3,2;
<<1;0,1,2,2,2,2,1,1,2,2;
<<6;2,2,1,3,2,0,3,1,4,2;
```

```
Metrics @ Router 8 [8008]

R1   R2   R3   R4   R5   R6   R7   R8   R9   R10
16   16   16   16   16   16   16   16   0    16
16   16   16   16   16   16   16   0    16   1
16   16   16   16   16   16   16   0    16   1
16   16   16   16   16   16   16   0    16   1
16   16   16   16   16   1    16   0    16   1
16   16   16   16   16   1    16   0    16   1
16   16   16   16   1    1    16   0    16   1
16   16   16   16   1    1    16   0    16   1
16   16   16   16   1    1    16   0    16   1
16   16   16   16   1    1    16   0    16   1
16   16   16   16   1    1    16   0    16   1
16   16   16   16   1    1    16   0    16   1
16   16   2    16   1    1    16   0    16   1
16   16   2    16   1    1    16   0    16   1
16   2    2    16   1    1    16   0    16   1
1    2    2    16   1    1    16   0    16   1
1    2    2    16   1    1    16   0    16   1
1    2    2    3    1    1    2    0    16   1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
1    2    2    3    1    1    2    0    3    1
```

Figure 4: Screenshot 3



```
soham@no0b4ever: ~/Desktop/EE706/EE706_assignment2_sem2

[Router 10]-Messages Rx & Tx

10;2,3,3,16,2,2,16,1,16,0;
<<8;1,2,2,3,1,1,2,0,16,1;
10;2,3,3,4,2,2,3,1,16,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
10;2,3,3,4,2,2,3,1,4,0;
<<8;1,2,2,3,1,1,2,0,3,1;
```

```
Metrics @ Router 10 [8010]

R1   R2   R3   R4   R5   R6   R7   R8   R9   R10
16   16   16   16   16   16   16   16   16   16
16   16   16   16   16   16   16   1    16   0
16   16   16   16   16   16   16   1    16   0
16   16   16   16   16   16   16   1    16   0
16   16   16   16   16   16   16   1    16   0
16   16   16   16   16   16   16   1    16   0
16   16   16   16   16   16   16   1    16   0
16   16   16   16   16   2    16   1    16   0
16   16   16   16   16   2    16   1    16   0
16   16   16   16   2    2    16   1    16   0
16   16   16   16   2    2    16   1    16   0
16   16   16   16   2    2    16   1    16   0
16   16   16   16   2    2    16   1    16   0
16   16   16   16   2    2    16   1    16   0
16   16   16   16   2    2    16   1    16   0
16   16   3    16   2    2    16   1    16   0
16   16   3    16   2    2    16   1    16   0
16   3    3    16   2    2    16   1    16   0
2    3    3    16   2    2    16   1    16   0
2    3    3    16   2    2    16   1    16   0
2    3    3    4    2    2    3    1    16   0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
2    3    3    4    2    2    3    1    4    0
```

Figure 5: Screenshot 4