**BLG433E**

*Computer Communications*

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# Report of Project 2

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## Data Structures & Sample Run

There are 3 classes implemented: Node, representing a station in the network; Link, representing the links between stations and Route, representing the path between two nodes, including the intermediate nodes. The objects of these types are kept in lists in the program.

### Node

Node class has the following fields:

- Id to identify the node
- X and Y coordinates
- Transmit and receive antenna gain values
- A list of adjacent nodes
- Dijkstra properties:
    - A Boolean visited
    - The cost of the node from source
    - A pointer to previous node for backtracking

### Link

Link class contains the fields:

- Two node pointers representing the link's terminal nodes
- Cost of the link, calculated using Friis Free Space Propagation Model

### Route

Route class has the fields below:

- Two node pointers representing the source and the target node in a route
- A list of node pointers representing the path
- The cost of the path

**Compilation:** make or g++ main.cpp Node.cpp Link.cpp Route.cpp
**Example Run:** ./a.out input.txt

There are two samples provided. **input_orig.txt** contains:

```
31.690000	5.930000
17.500000	5.380000
14.340000	25.950000
21.010000	42.520000
26.630000	38.130000
1.660000	14.930000
25.770000	30.060000
5.980000	3.000000
28.370000	0.040000
28.180000	9.610000
```

The above file constitutes the following graph:

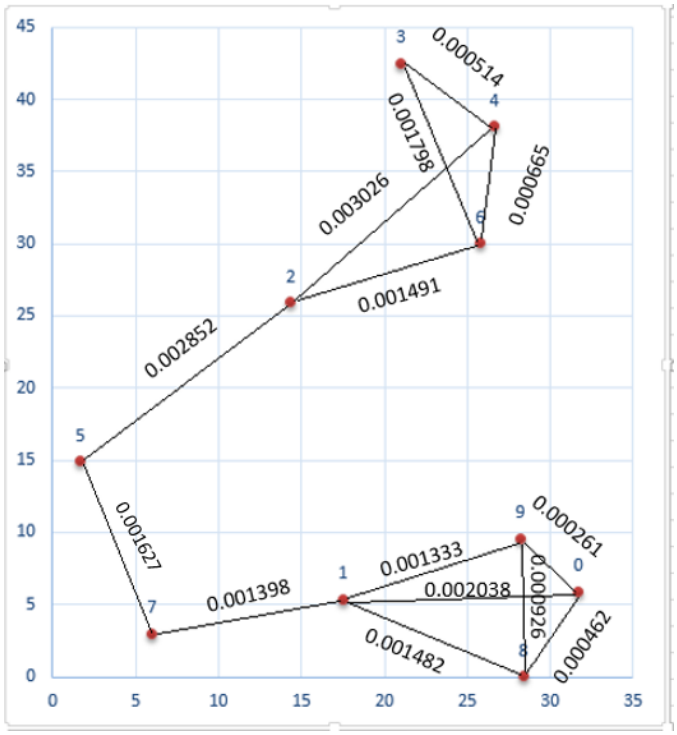


*Figure 1: Two kites tied together, one has a broken edge and random numbers are floating all around. No, wait, It's the graph representing the nodes given in the above text file with the edge costs specified.*

Since this is a connected graph, the node 5 is shifted in the Y coordinates: (1.66, 24.93) instead of (1.66, 14.93). Thus the link between 5 and 7 is lost. This situation is realized in the **input.txt** file for testing the program on a disconnected graph. Notice that the cost between 5 and 2 is changed as well. The program's output for **input.txt** is as follows:

```
================================================================

====================    Routing Table    ====================

================================================================
0 -> 1 costs 0.00159529 == 0-->9-->1
0 -> 7 costs 0.00299405 == 0-->9-->1-->7
0 -> 8 costs 0.00046210 == 0-->8
0 -> 9 costs 0.00026143 == 0-->9
1 -> 7 costs 0.00139876 == 1-->7
1 -> 8 costs 0.00148263 == 1-->8
1 -> 9 costs 0.00133386 == 1-->9
2 -> 3 costs 0.00267124 == 2-->6-->4-->3
2 -> 4 costs 0.00215716 == 2-->6-->4
2 -> 5 costs 0.00163578 == 2-->5
2 -> 6 costs 0.00149137 == 2-->6
3 -> 4 costs 0.00051408 == 3-->4
3 -> 5 costs 0.00430702 == 3-->4-->6-->2-->5
3 -> 6 costs 0.00117987 == 3-->4-->6
4 -> 5 costs 0.00379294 == 4-->6-->2-->5
4 -> 6 costs 0.00066579 == 4-->6
5 -> 6 costs 0.00312715 == 5-->2-->6
7 -> 8 costs 0.00288139 == 7-->1-->8
7 -> 9 costs 0.00273262 == 7-->1-->9
8 -> 9 costs 0.00072353 == 8-->0-->9
================================================================
```

Given the formula

$$P_r = P_t G_t G_r \frac{\lambda^2}{(4\pi d)^2}$$

We know that $P_{max} = P_t = 3.2mW$. We arrange the formula as follows to find $d_{max}$

$$d_{max} = \frac{\lambda}{4\pi} \sqrt{\frac{P_{max} G_t G_r}{P_r}}$$

Where

- $\lambda = 0.125\ m$
- $G_t = G_r = 10$
- $P_{max} = 3.2\ mW$
- $P_r = P_{th} = 0.1\mu W$

The formula yields $d_{max} = 17.79406\ m$.