# ESE 575 Assignment #4 Report

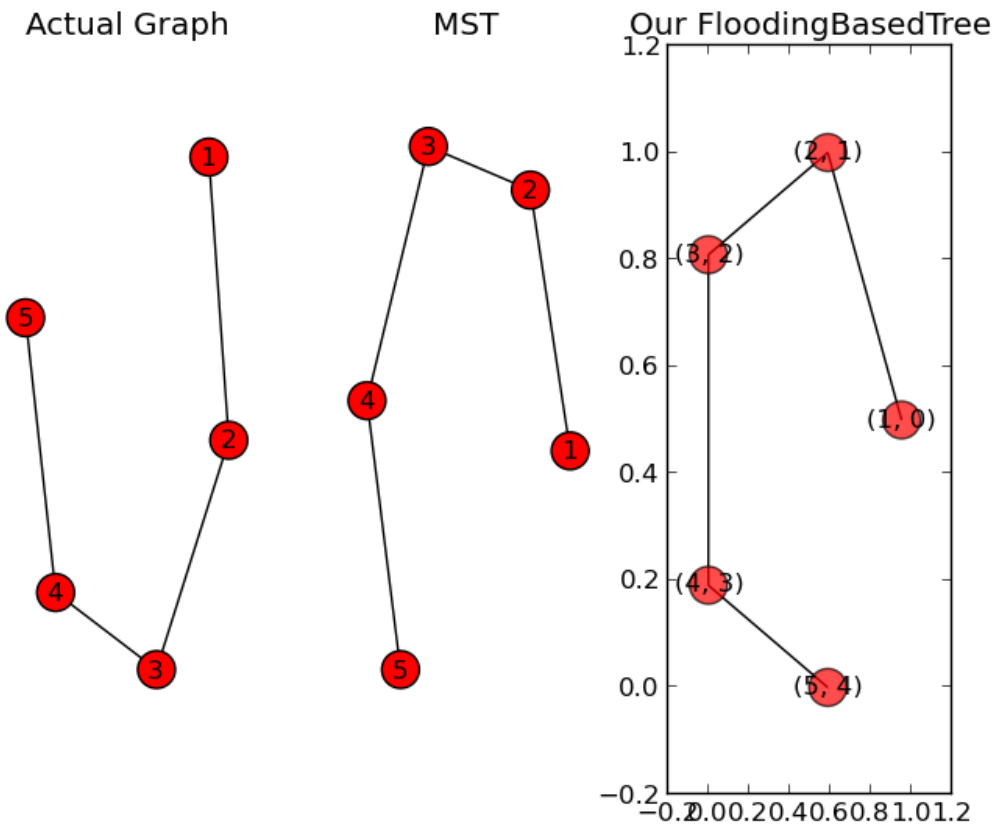
## Team: Tharun and Mohammad

**Task 1: Write a tiny-os app for FloodingBased Tree construction.**

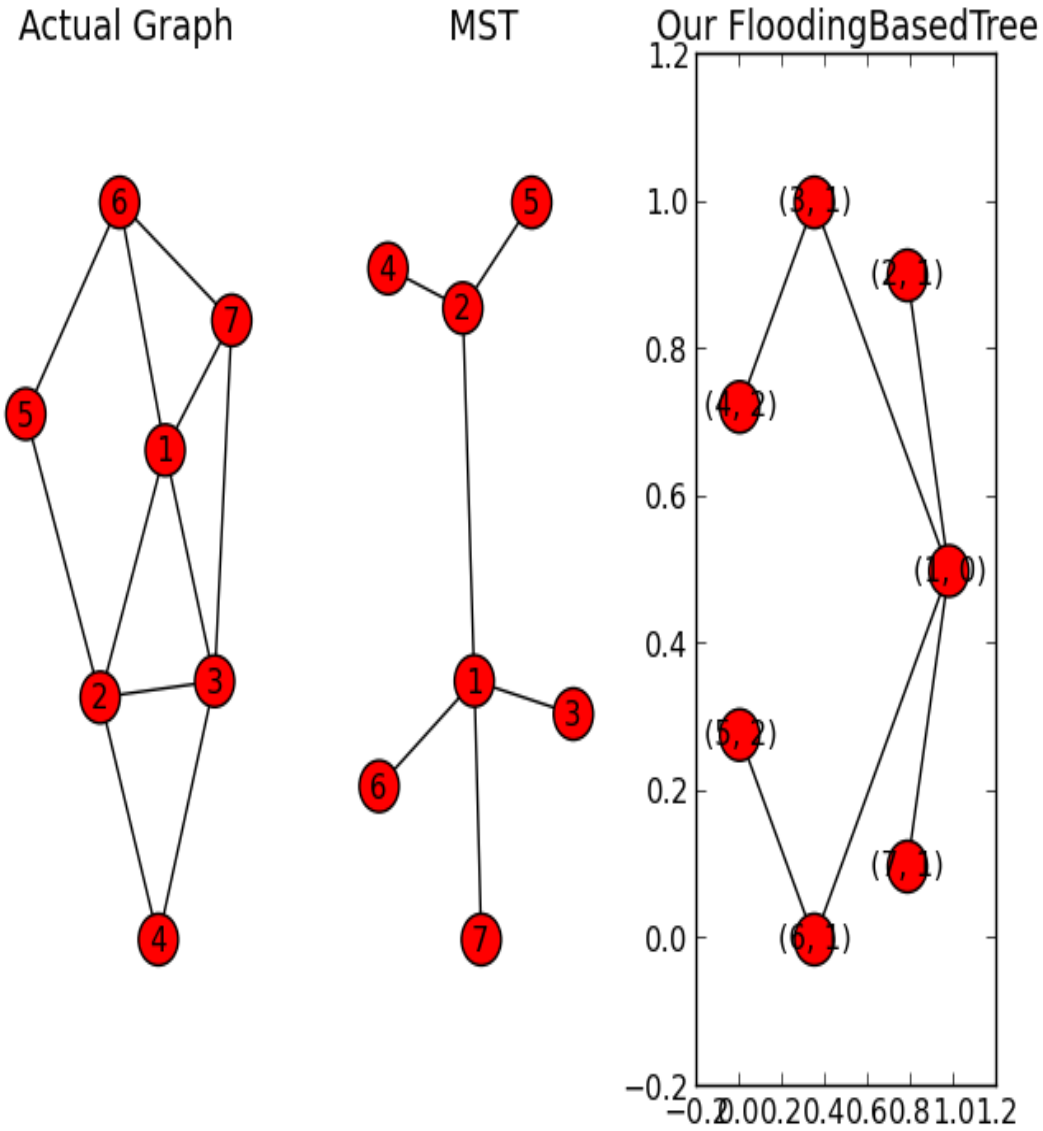
In this task we were asked to write to code for tree construction using flooding, where each level starting from the root node (1 in our case) gets a level assigned to itself.

Here are our outputs for various topologies :

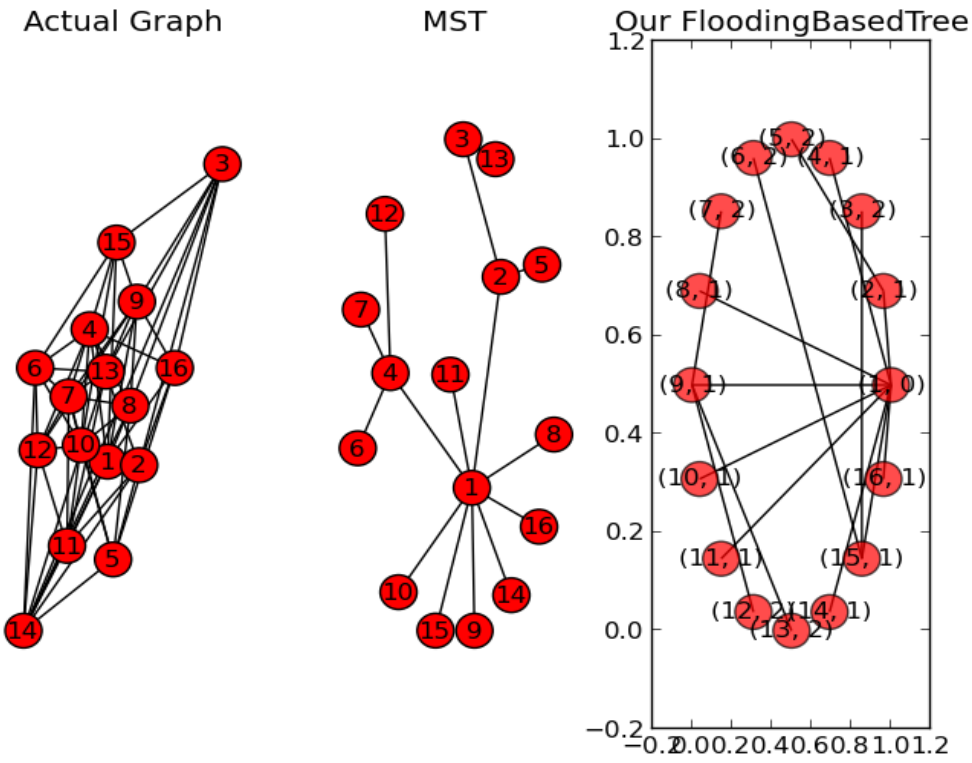
1. Here is a topology of 5 nodes, and the corresponding Minimum Spanning Tree and our flooding based Tree (Node labels are [Node number, level])



2. Here’s a topology of 7 nodes.



3. Here's our topology of 16 nodes




More figures from our simulation can be found at :
https://www.dropbox.com/sh/0bx7oy5xfuuxtdl/NJkpmVvRDG

**Comments on the optimality of the resulting tree:**

The resulting tree from our flooding based tree algorithm gives us a close approximation to the Minimum Spanning Tree.

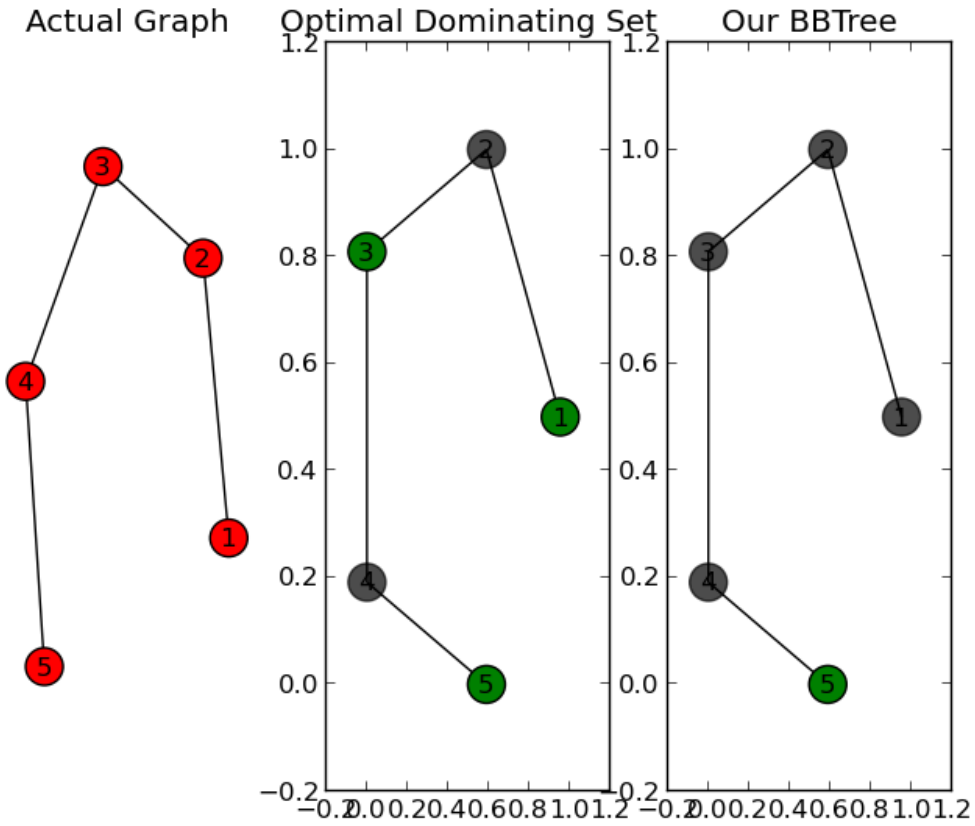
There are several benefits associated with this approximate algorithm:
1. In general, the computational costs needs to accurately establish a minimum spanning tree using Prim's algorithm and root as 1 are high.
2. Especially, in our case of sensor networks, it is clearly not worth performing a robust Minimum Spanning Tree Algorithm.

From our simulations, we found that the distance of other nodes to the root in our tree is approximately close to the distance of other nodes to root in the Minimum Spanning Tree.

**Task 2: Write a tiny-os application for constructing a Backbone Tree.**

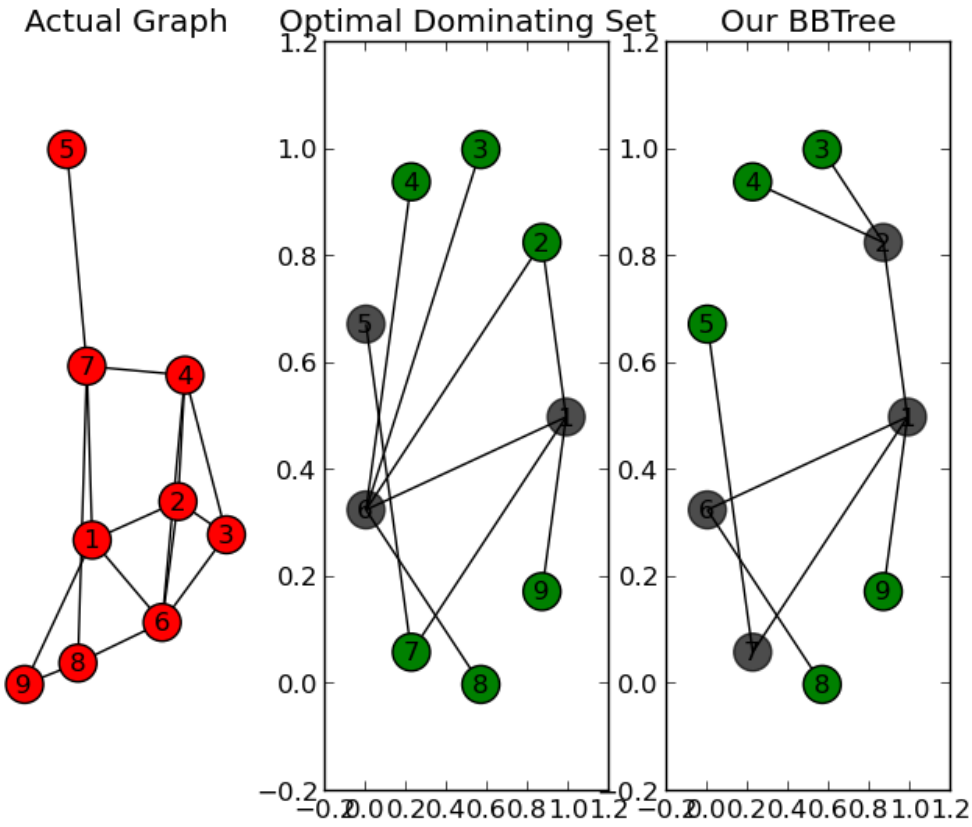
We were asked to compare the resulting backbone tree with the dominating sets.
Here are our outputs for this task (nodes in the dominating sets are represented by black)

1. Here's our topology of 5 nodes, we observe that our backbone tree consists of 4 black nodes whereas the optimal dominating set consists of just 2 nodes.

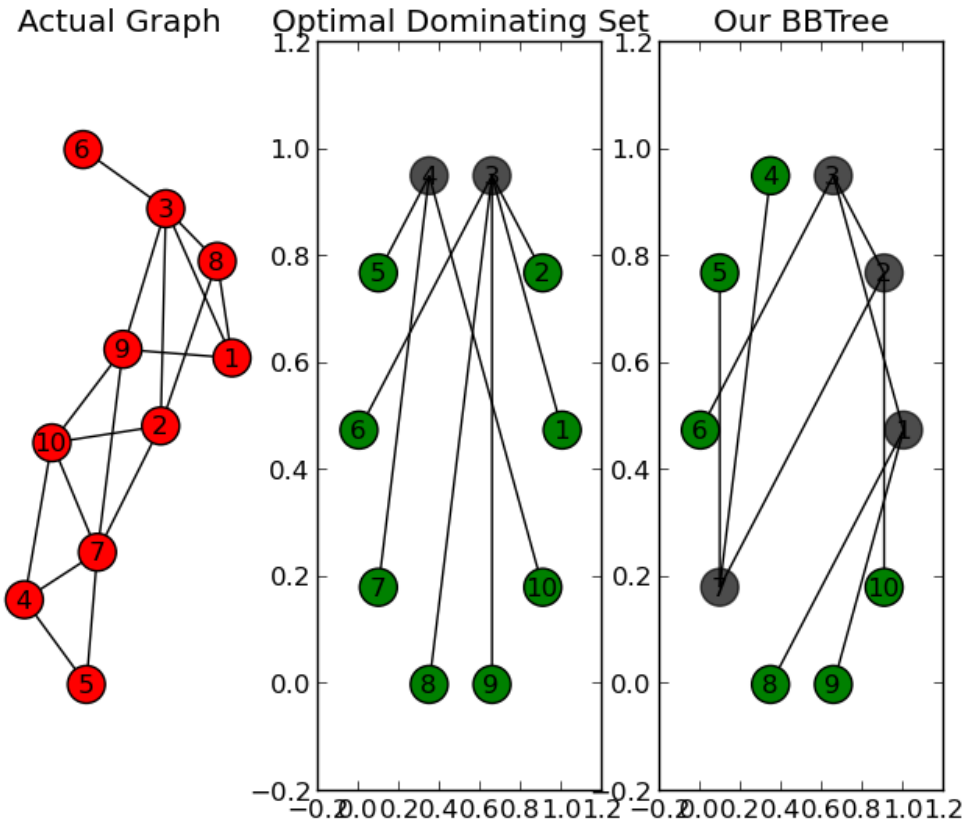



2. Here's our topology of 9 nodes. Our tree's dominating set consists of 4 nodes, Optimal

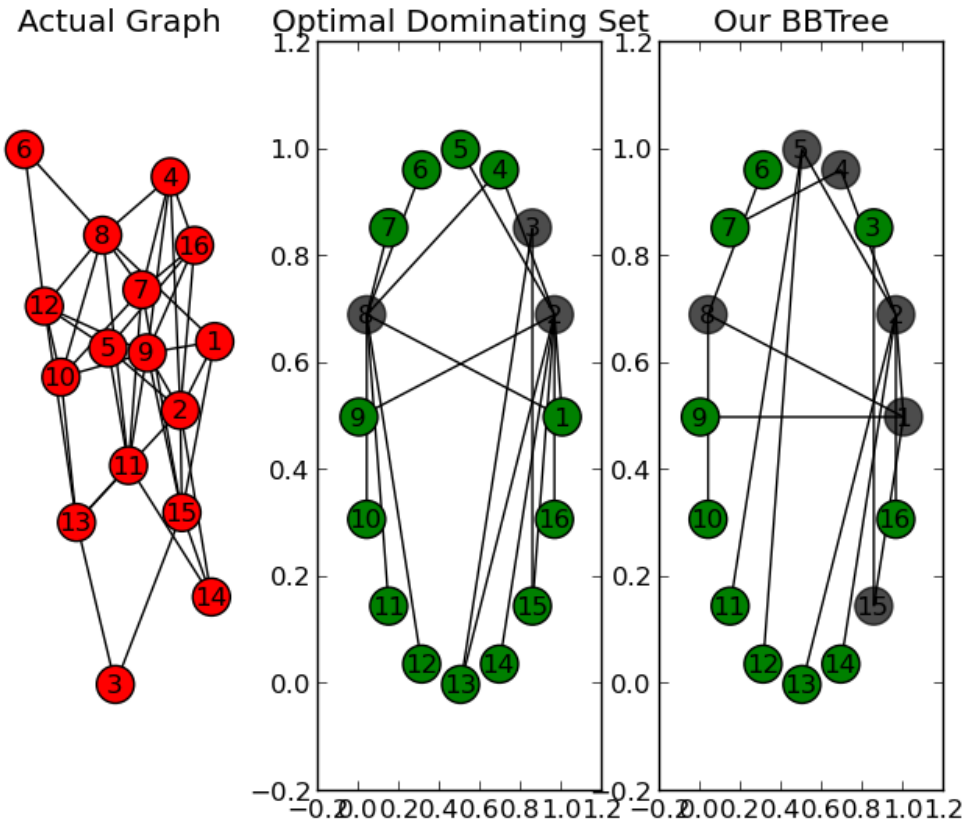
dominating set consists of 3 nodes.




3. Here's a topology of 10 nodes. Optimal Dominating Set : 2 , Our Backbone Tree: 4




4. Here's a topology of 16 nodes. Optimal Dominating Set: 3. Our Backbone Tree: 6




You can view more simulation figures at :
https://www.dropbox.com/sh/hhu2mhc7shpqrzm/RDFefOIYfc

**Comments on the optimality of the minimal dominating set produced by our backbone tree construction vis-a-vis optimal minimal dominating set:**

We observe that the algorithm we employ to derive the minimal optimal set doesn't give us the optimal dominating set. However, it gives us a close approximation to the order of 2. Given that finding the optimal dominating set is a NP-complete problem, an approximation algorithm like ours which is optimal to the order of 2 is an encouraging result.