Robot Dolphin Rodeo
CISC 320 First Programming Project

Due Friday, Apr 17, 2015

March 25, 2015

Amid concerns about rising sea levels and other changes in the oceans that threaten livelihoods and political stability around the world, the Department of Homeland Security is sponsoring a project to monitor oceanic conditions around the world with a network of robot "dolphins", which have come to be called "rodos". Each rodo carries sensors to monitor water temperature, salinity, and plankton levels. Each has capability to receive and transmit data to nearby rodos (within a few kilometers) and to receive and transmit info to a satelite controller as well. Finally the rodos can rise and descend in the water using compression and expansion (change in density), and to make limited horizontal headway by controlling fins during ascent and descent. The energy budget is extremely limited for operating all these systems, so minimizing costs of communications is strongly desired. Because of variations in location and status of transmitters, the set of rodos that can receive communication from a given rodo varies over time. Also, since transmission levels vary to preserve power and because transmitters and recievers may individually degrade in the ocean environment, it may be that rodo a can send a message to rodo b, but not vice versa. Communication links are one way in general.

The basic operating principle of the system is that the satelite communicates with a designated base rodo once each orbit (about an hour and a half). The base rodo broadcasts the instructions through the rodo network expecting to reach every rodo.

After receiving their instructions, the rodos engage in another data communication, this time each rodo sends it's sensor data along with a list of those rodos whose transmissions it can hear. This communication follows the links of a "data tree" which brings the information to a designated node affectionately known as the "sponge". The sponge assends to the surface and sends the data to the satelite.

Long story short, the instruction stream contains two trees, a command tree rooted at the base and a data tree rooted at the sponge. The sponge communicates the current state of communication connectivity to the satelite, which then plans the trees, base, and sponge for the next round. This is where you come in.

At Mooglu.com you are project leader to provide DHS with code for the satelite. The job is to take in the directed graph of available commmunication links among the rodos (received from the sponge last round) and provide a list of valid bases and a list of valid sponges based on that graph. The input is a standard graph file format (number of vertices and edges on first line followed by lines each containing one directed edge). The output is the two lists as indicated below. A list can be empty.

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Example input:
6 9
1 2
2 3
3 1
2 4
4 1
1 5
1 6
2 6
5 6
Output:
Bases: 1, 2, 3, 4
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Sponges: 6
Another example:
3 3
1 2
2 3
3 1
Output:
Bases: 1, 2, 3
Sponges: 1, 2, 3
```

You may work in teams of two. Submit your solution on Sakai. The solution must contain team member names. The members of a team must both submit, even though their submissions are identical. Make your code as efficient as you can. Energy savings on the satelite is important too.
Some example data will be given. Projects that correctly identify bases and sponges on sample data will compete for scalability (timings taken for really large rodo networks). Does your code run fast enough to be used on DHS' next project, namely to deploy millions of the next generation of rodo design so as to cover the world's oceans at a density of one per hectare?