

App Development for Analyzing Biological Networks

Students: Kyle Brindle, Slav Lazurenko, Osmany Pujol, Anthony Abello, Sage Pages

Mentor: Ananda Mondal

Instructor/Faculty: Masoud Sadjadi, Florida International University

PROBLEM

Cytoscape is a tool used to analyze large graphs and networks. CyFinder is a plugin for Cytoscape meant to incorporate algorithms for analyzing networks into CyFinder. SubgraphFinder is the software program where the logic for those algorithms are written.

One main focus of the project was to develop the map equation as a tool for measuring the efficiency of community partitions within networks. The other main focus was to implement the Infomap algorithm, which uses the map equation in order to detect communities in networks.

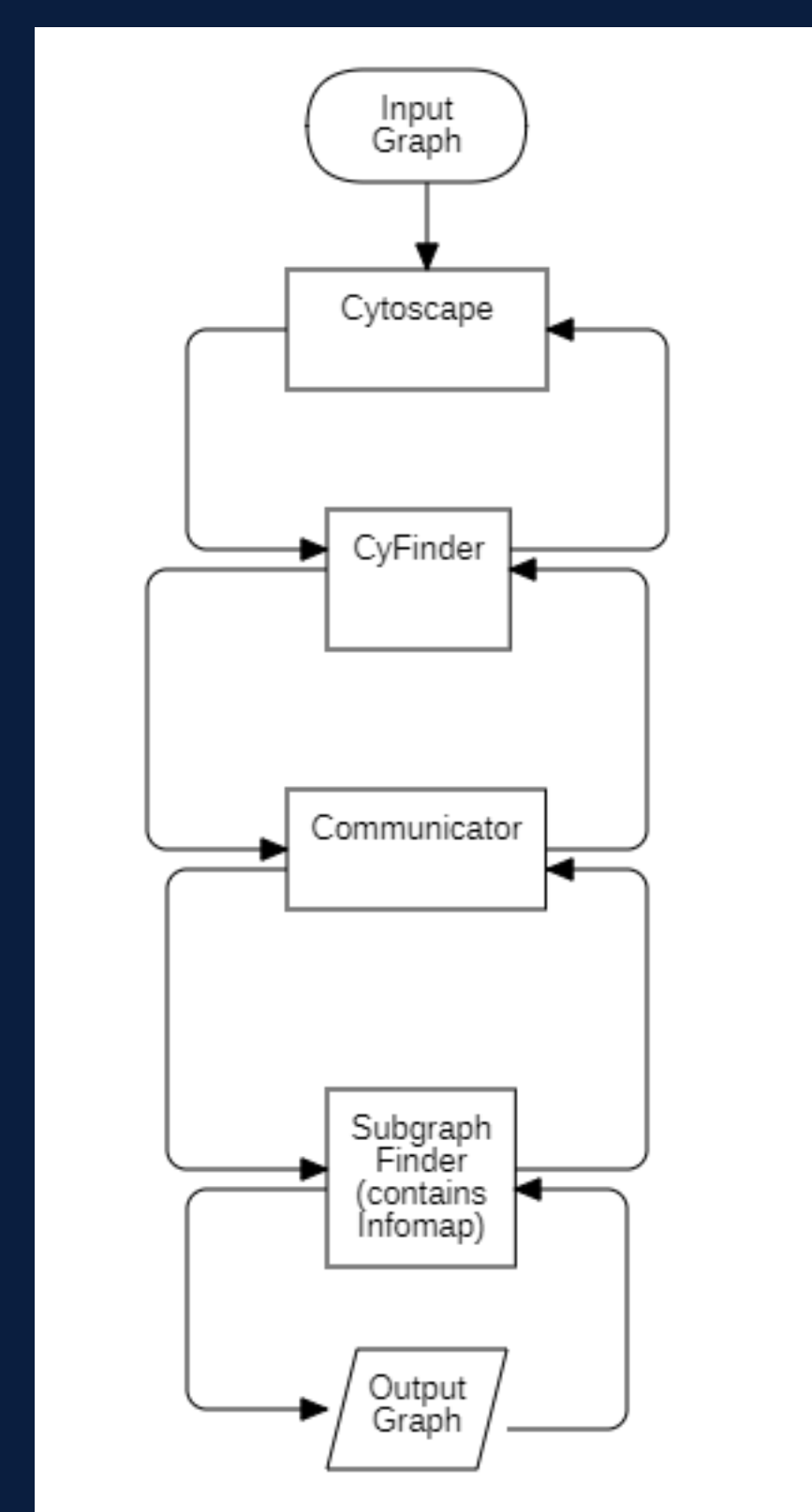
CURRENT SYSTEM

The current implementation of CyFinder introduces several algorithms for community detection. The project was to implement the map equation, a tool that can be used to measure the efficacy of different communities, as well as the Infomap community detection algorithms to find communities within Networks.

REQUIREMENTS

- Java 11
- Maven
- Apache Ant
- Cytoscape 3.8.0

SYSTEM DESIGN



IMPLEMENTATION

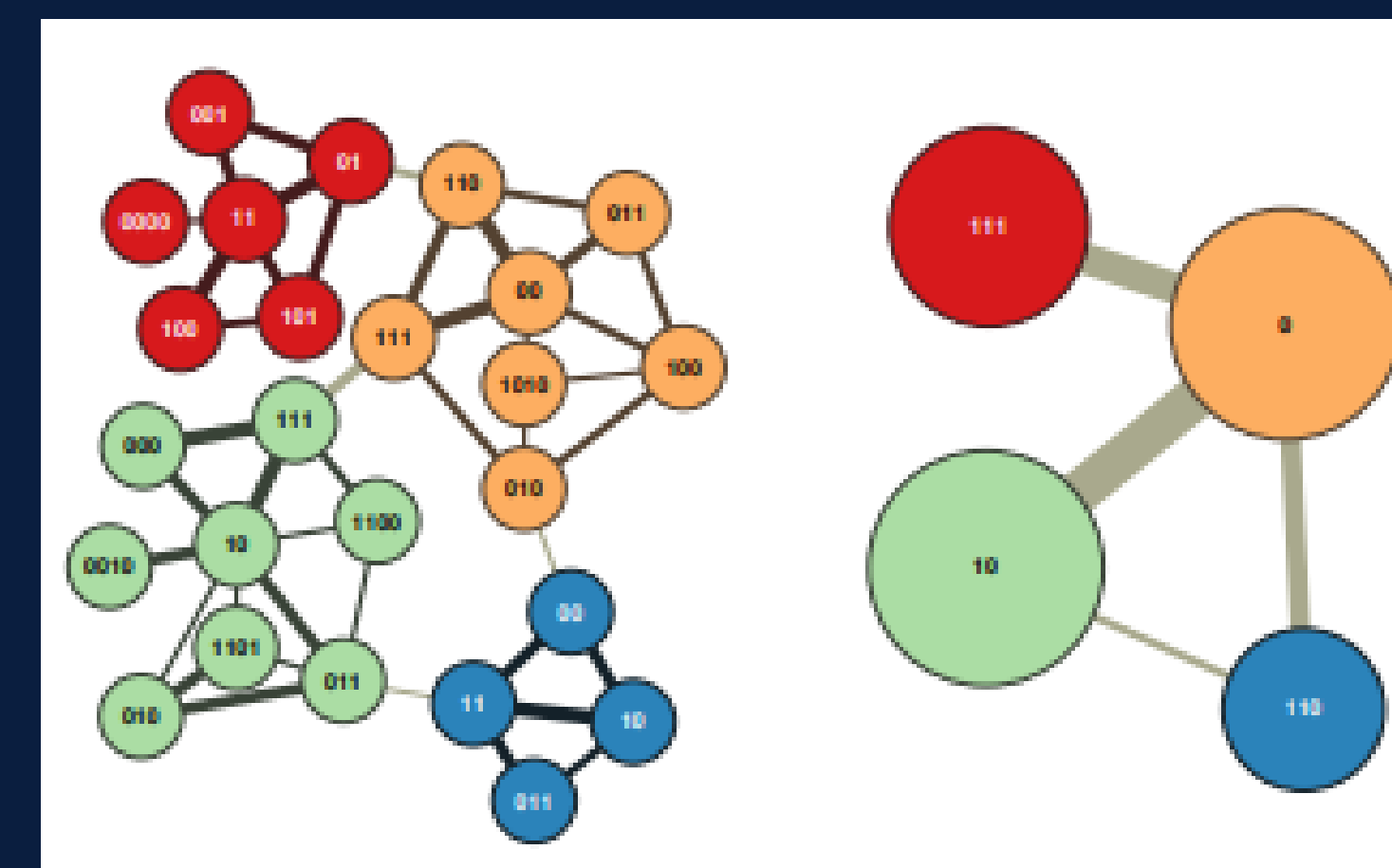
The Map Equation formula was taken from a paper *The map equation* by M. Rosvall and D. Axelsson and implemented in Java in SubgraphFinder.

Infomap was based on algorithms from another paper by Rosvall. It was also coded in Java in SubgraphFinder

Both map equation and Infomap are then compiled and implemented into the CyFinder plugin for Cytoscape.

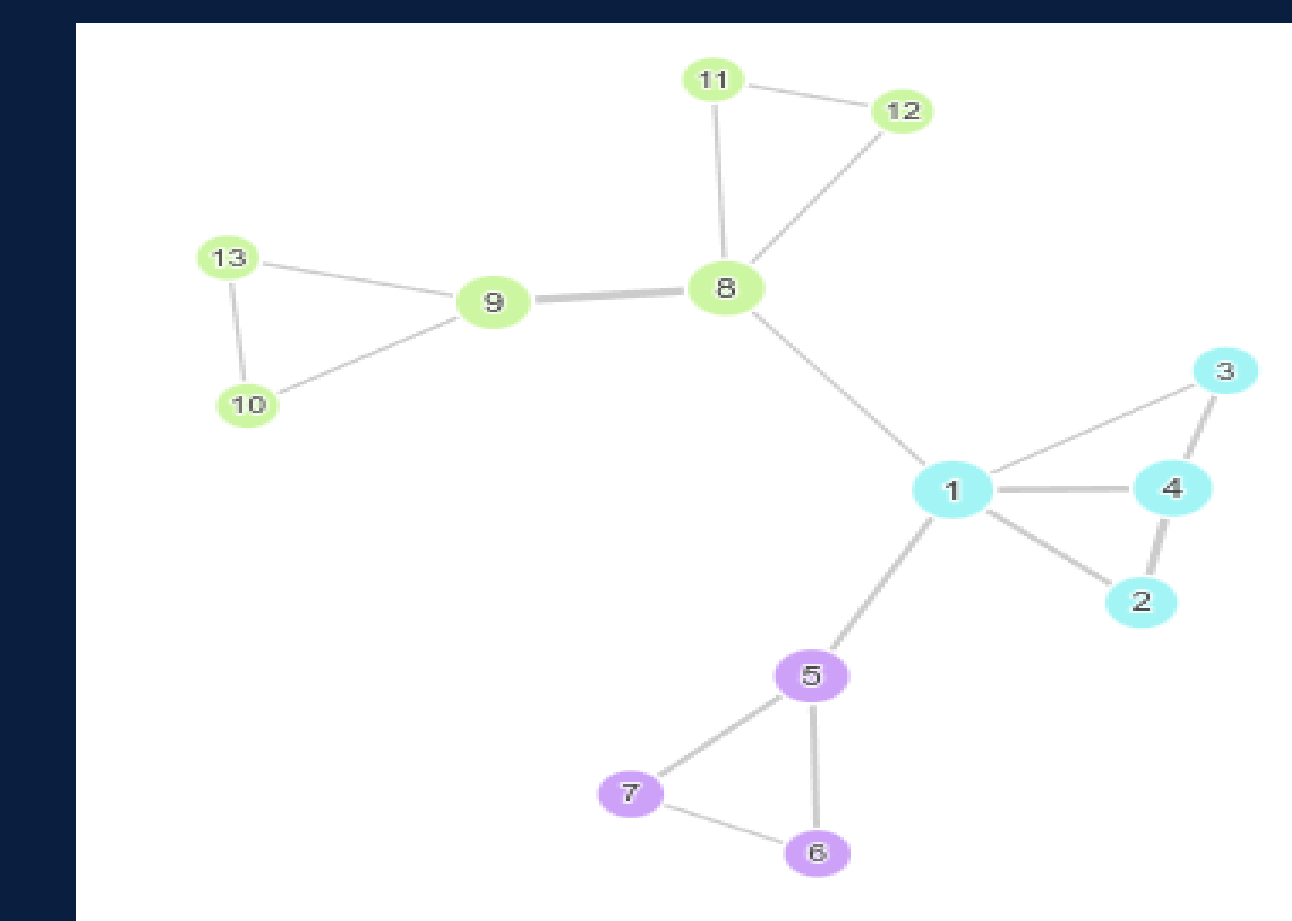
$$L(M) = w_{\gamma} \log(w_{\gamma}) - 2 \sum_{i=1}^m w_{i\gamma} \log(w_{i\gamma}) \quad (5)$$

$$- \sum_{\alpha=1}^n w_{\alpha} \log(w_{\alpha}) + \sum_{i=1}^m (w_{i\gamma} + w_i) \log(w_{i\gamma} + w_i).$$



VERIFICATION

We tested the map equation and Infomap on graphs. We ran the same graphs on an online implementation of Infomap done by the authors of the research paper and compared the results.



2.60

```
{0=[1, 2, 3, 4], 1=[5, 6, 7], 2=[8, 9, 10, 11, 12, 13]}
2.6024437910254266
```

SUMMARY

The project was to implement the map equation and Infomap. I contributed to implementing the math of the map equation into Subgraph Finder, as well as the implementation of the low level community finder portion of the Infomap algorithm and transformation of those low level communities into a newly implemented type of node to allow for the recursion of the Infomap algorithm.

REFERENCES

The map equation by Martin Rosvall and D. Axelsson - September 23, 2009

Mapping Higher-Order Network Flows in Memory and Multilayer Networks with Infomap by Martin Rosvall, Daniel Edler, and Lidvig Bohlin - June 15, 2017

ACKNOWLEDGEMENT

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