



Knight Foundation
School of Computing
and Information Sciences

Knight Foundation School of Computing and Information Sciences

Fall 2022 Senior Design Project

CyFinder

Students: Jesus Rodriguez

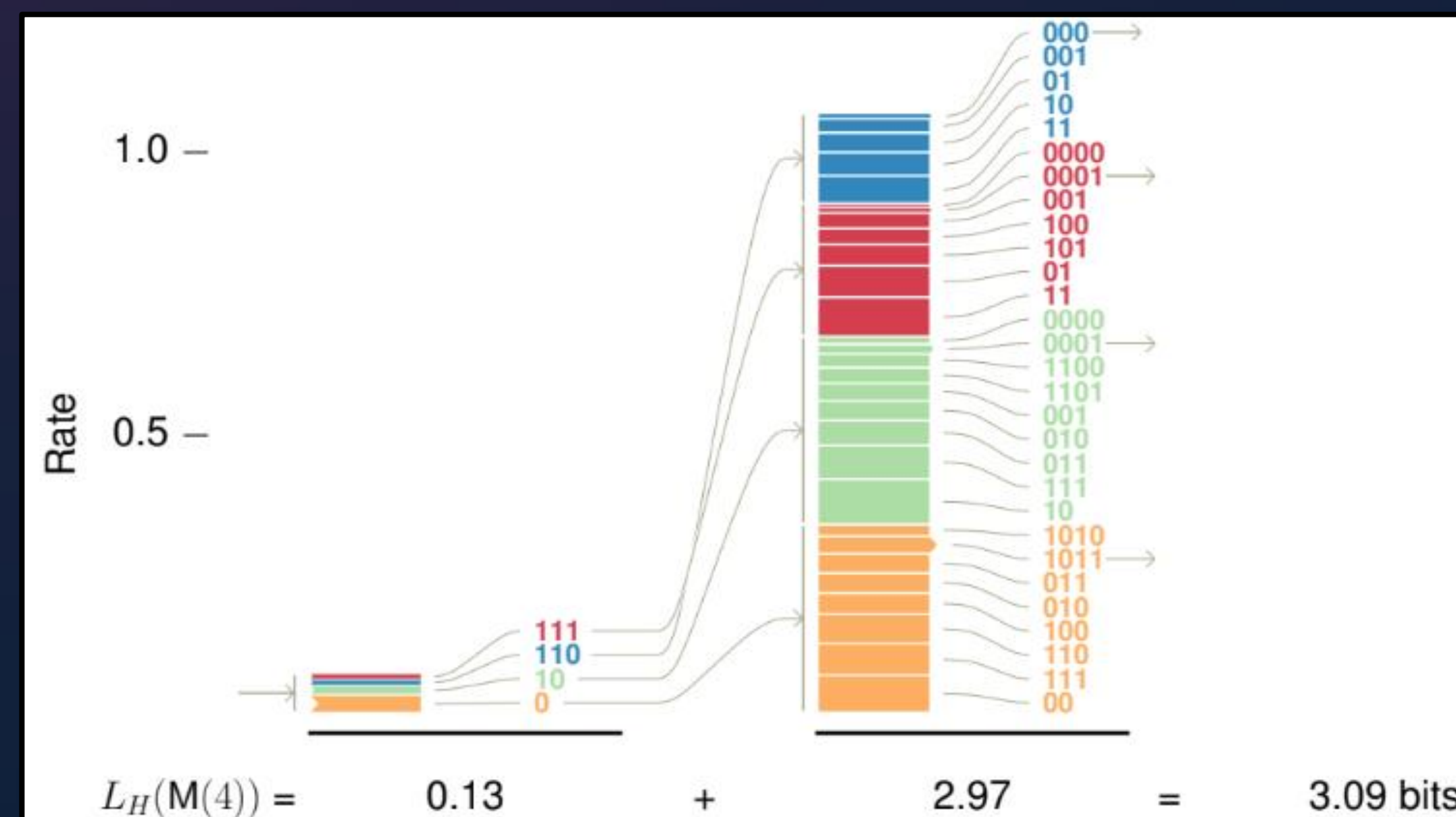
Mentor: Ananda Mondal, Raihanul Bari Tanvir

Instructor/Faculty: Masoud Sadjadi, Florida International University

PROBLEM

Cytoscape is a bioinformatics software that allows researchers to graph networks and interact with them by using built-in and third-party plugins to add functionality to the program. The current design of the CyFinder project is a plugin that gives users the ability to perform many types of clustering, pathfinding, and other algorithms over these complex biological networks. The focus of the project is to expand on the algorithms implemented in the CyFinder plugin, adding more community detection algorithms as well as fixing bugs, UI, and edge-case errors to improve the overall functionality of the plugin.

VERIFICATION



To calculate the result seen above for any given graph, we use the Map Equation. Implementing the equation into the code nets us the result:

```
1 usage: Jesus *
public double MapEquationUndirected(ArrayList<Double> wy, ArrayList<Double> w,
    ArrayList<ArrayList<Double>> wi, int nodeNum,
    int modNum){
    MapEquation map = new MapEquation();
    double part1 = map.SigmaWyLogSigmaWy(modNum, wy);
    double part2 = map.SigmaNotationWiyLogWiy(modNum, wy);
    double part3 = map.SigmaWaLogWa(nodeNum, w);
    double part4 = map.LongSigmaWiyAndWi(modNum, wy, communities, wi);
    return part1 - (2 * part2) - part3 + part4;
}
```

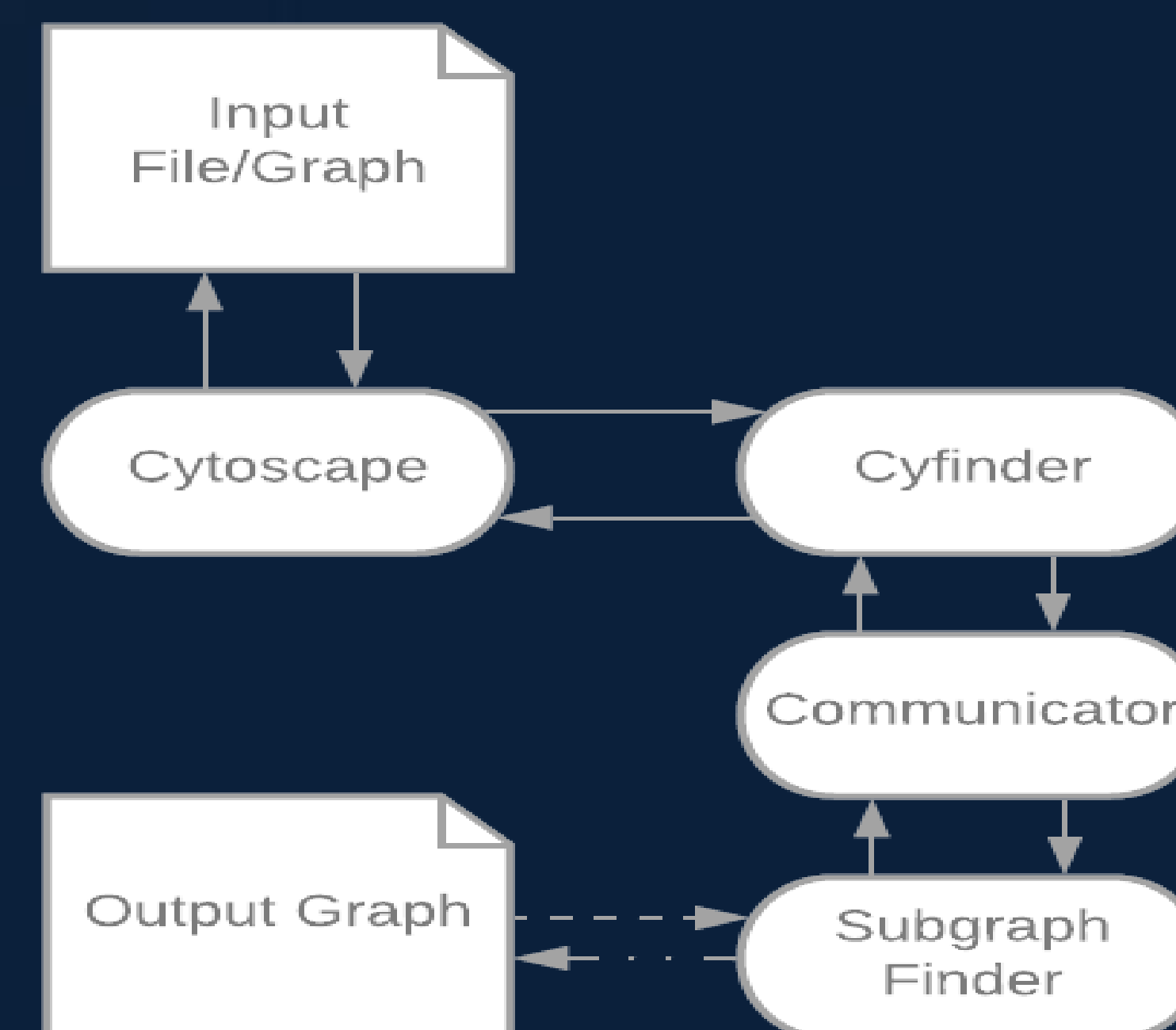
```
avgBitLength = MapEquationUndirected(wy, w, wi, nodeCount, communities.size());
```

The average bit length of this partitioning is: 3.9784355165349954

CURRENT SYSTEM

The current system design of the CyFinder plugin allows a user or researcher to take imported graphs, either directed or undirected, and use them either within the Cytoscape interface or the implemented Command Line Interface within the Subgraph Finder project. In expanding the current system, we added one of the four remaining algorithms to be accessed within the Subgraph Finder (backend of the CyFinder plugin), known as the InfoMap Algorithm

SYSTEM DESIGN



SUMMARY

- Implemented a random walker to traverse any given graph a set amount of times while accounting for the frequencies at which each node in a graph is traversed
- Created a method that incorporated the frequencies of each node traversed through the random walker, and used the Huffman coding classes to create unique Huffman codes for each node in a given partitioning of a graph, using the Louvain algorithm to partition the graphs
- Implemented helper methods to help out with the calculations needed to compute the map equation for an undirected graph, and utilized the methods to be able to compute the map equation for any given graph or any given partitioning of a given graph in the Subgraph Finder portion of the project

REQUIREMENTS

Software:

- Java 13.0
- Apache Ant
- Apache Maven
- Eclipse (Any other IDE should work just fine)
- Cytoscape
- Cytoscape API
- GitHub Desktop (Strongly Recommended)

Version Control:

- Git
- GitHub (<http://www.github.com>)

IMPLEMENTATION

- Java 13.0** – Main Language used to create CyFinder
- Maven** – Combined logic with the GUI to generate JAR
- Apache Ant** – Responsible for building the module that contains the logic for CyFinder
- Cytoscape API** – Necessary tools required for Cytoscape integration.
- Cytoscape 3.9** – Core software.

REFERENCES

Rosvall, M., Axelsson, D., & Bergstrom, C. T. (2010). *The map equation*. mapequation. Retrieved November 26, 2022, from <https://www.mapequation.org/publications.html>

Rosvall, M., & Bergstrom, C. T. (2008, January 29). *Maps of random walks on complex networks reveal community structure*. pnas. Retrieved November 27, 2022, from <https://www.pnas.org/doi/10.1073/pnas.0706851105>



Engineering
& Computing

ACKNOWLEDGEMENT

The material presented in this poster is based upon the work supported by Ananda Mondal. We/I thank Ananda Mondal for his/her/their assistance and mentorship that I/we received throughout the senior design project.

FLORIDA INTERNATIONAL UNIVERSITY