

Modularity-based Community Detection in Bacterial and Viral Networks

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Abstract

This paper investigates community structure in bacterial and viral protein similarity networks using modularity-based community detection methods. We compare several algorithms and perform a sensitivity analysis on the resolution parameter using Adjusted Rand Index and Adjusted Mutual Information.

1 Introduction

1.1 Motivation

1.2 Definition of a Network

1.3 Mathematical Representation

1.4 What Can We Do with Networks?

2 Network Summary Statistics

2.1 Basic Metrics

2.2 Degree Distribution

2.3 Centrality Measures

3 Similarity Measures for Community Comparison

3.1 Rand Index

3.2 Adjusted Rand Index

3.3 Adjusted Mutual Information

3.4 Comparison of ARI and AMI

4 Community Detection Methods

4.1 Modularity

4.2 Edge Betweenness (Girvan–Newman)

4.3 Louvain Method

4.4 Leiden Method

5 Data Description

5.1 Data Source

5.2 Network Structure

5.3 Preprocessing

6 Experimental Setup

6.1 Implementation

6.2 Hyperparameters

6.3 Evaluation Criteria

7 Results

7.1 Descriptive Comparison of Bac and Vir

7.2 Method Comparison

7.3 Hyperparameter Sensitivity Analysis

7.4 Interpretation of Results

8 Discussion

9 Conclusion