

Community detection in networks

1 Introduction

Modern networks are growing exponentially in size, diversity and complexity. Due to the changes in networks, a wide variety of networks are emerging, such as IoT data, wireless sensor data, cloud data, co-citation in academic fields, and social network data. A community in a network is composed of a set of nodes that are highly connected to each other, unlike other nodes in the network that have relatively random and scattered relationships. A key role of community detection algorithms is that they can be used to extract useful information from the network.

The modularity is used to measure whether the division of a community is a relatively good result. A relatively good result has a high similarity of nodes inside the community and a low similarity of nodes outside the community.

$$Q = \frac{1}{2m} \sum_{i \neq j} \left(A_{ij} - \frac{k_i k_j}{2m} \right) \delta(C_i, C_j)$$

A_{ij} is an element of the adjacency matrix of the network, C_i, C_j denotes the two communities where node i and node j are located respectively, and m is the total number of edges in the network, k_i denotes the degree of node i . If node i and node j are in the same community, $\delta(C_i, C_j)$ is 1, otherwise $\delta(C_i, C_j)$ is 0.

2 Purpose

This Lab focuses on the community detection algorithms for networks. In this Lab, you will use python to complete community detection under a specific network and visualize the network based on the results.

You need to find data set on the Internet by yourself, use any community detection algorithm to detect the community, and visualize the network based on the community detection results. After programming, you need to answer two questions.

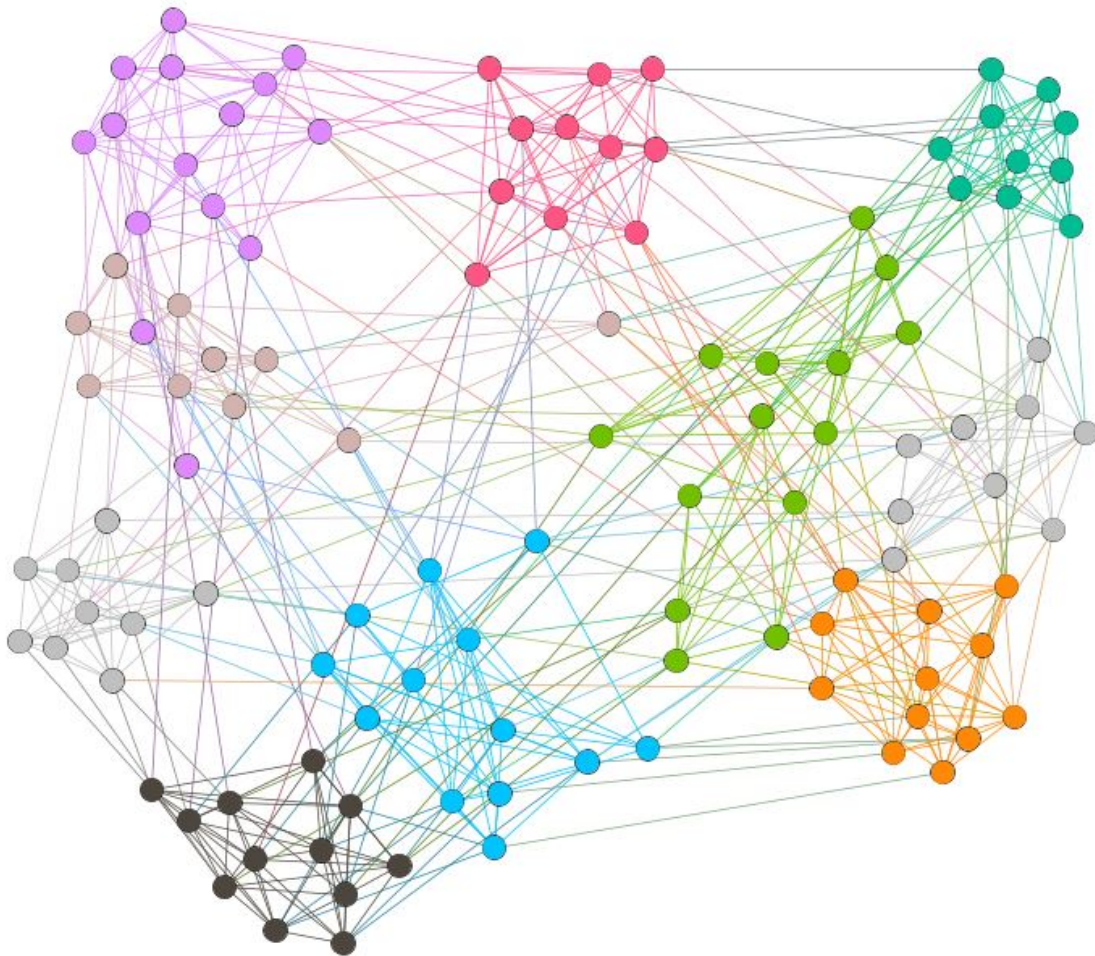


Figure 1: Network visualization by the result of community detection

3 Question

1. Briefly describe the principle of the community detection algorithm you use.
2. In addition to visualization, what other applications does the community detection algorithm have?
Please list at least three.