The Insight to the Girvan-Newman Algorithm: "*Detecting Communities in Network Systems*"

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Introduction

The Girvan–Newman algorithm detects communities by progressively removing edges from the original network. The connected components of the remaining network are the communities. Instead of trying to construct a measure that tells us which edges are the "**most central**" to communities, the **Girvan–Newman** algorithm focuses on edges that are most likely "between" communities. Communities are clusters of tightly connected nodes.

Vertex Betweenness

This is the first method of detecting node "centrality" within a network. Vertex betweenness is relevant in situations where the network modulates transfer of goods between known START and END points. That is if the goods are looking for the shortest path.

Hierarchical Method
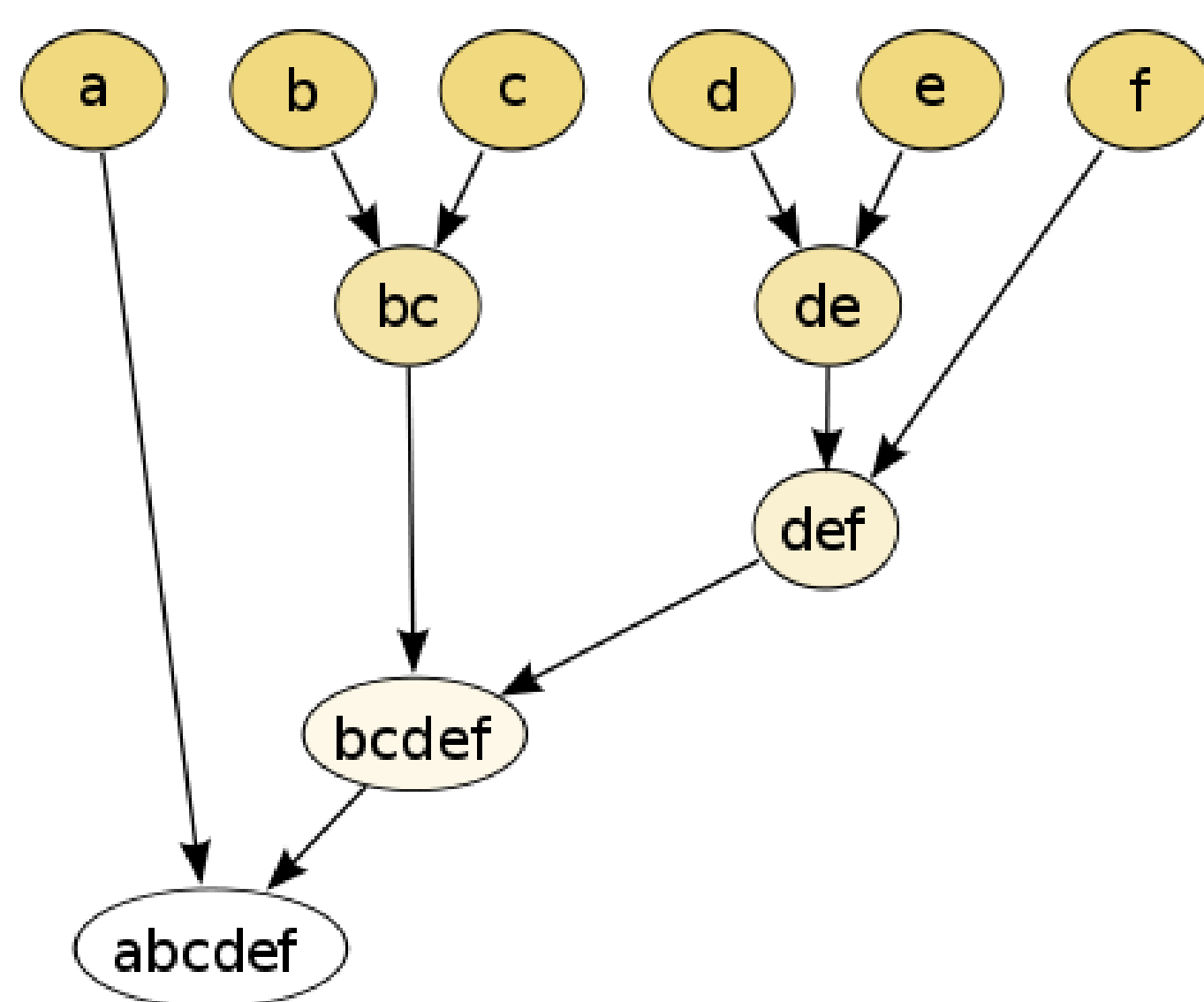
This algorithm uses what is known as a hierarchical method, meaning from the Top Down, to detect these communities in complex network systems. Known as Divisive, meaning all observations start in one cluster, and splits are performed recursively as one moves down the hierarchy. These results usually are shown in what is known as a *Dendrogram*. A Dendrogram is a "tree" diagram that shows the hierarchical clustering, frequently used in biology to show clusters of gene samples.

Network Cluster

Network Cluster example

Detecting the between node

$B_{ij} \gg 0$
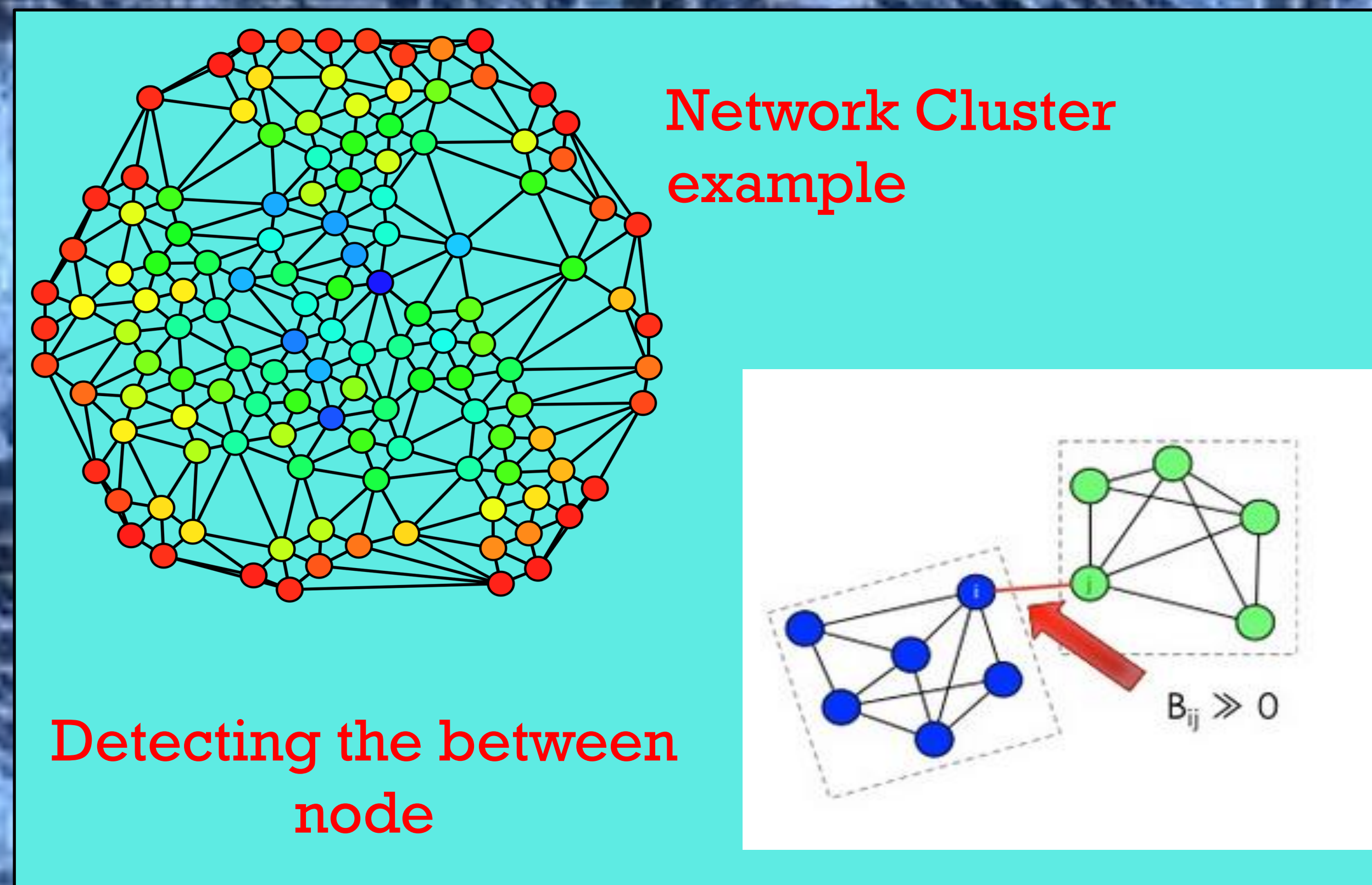
As mentioned before the Girvan-Newman Algorithm seeks to detect which nodes are the ones with the most frequent "through" activity that connects communities. The top left diagram shows the overlay of a structured network. And the bottom left image shows the path that connects those communities, in which case the Girvan – Newman Algorithm deletes that node and repeats the search for the node with high density until the underlying structure of the network is revealed.

Implementation

How many Facebook Messenger users:

800 million users
Last updated 4/22/15

Number of downloads for the Facebook Messenger app on Google Play:

1 billion

Last updated 6/9/15

This method is used to seek out the central node between communities. This can be used in many aspects of everyday life. For example this generations favorite past time, social media. Within social media an analyzer can determine where users interact with each other the most. Prime example is Facebook. With Facebook there are many aspects of letting the world know your status, who your friends are, what events you are attending and so fourth. The betweenness comes into play when we get to communicating, or Facebook messenger. As Facebook has a messaging option on its site, it was noticed that many people utilize this area of the site, high density. Therefore pushing to create a mobile massager app that takes away the middle man, the Facebook website in general and giving users a straight path to socializing with their friends.

Micro-Media

Micro-Marketing in a sponsored search
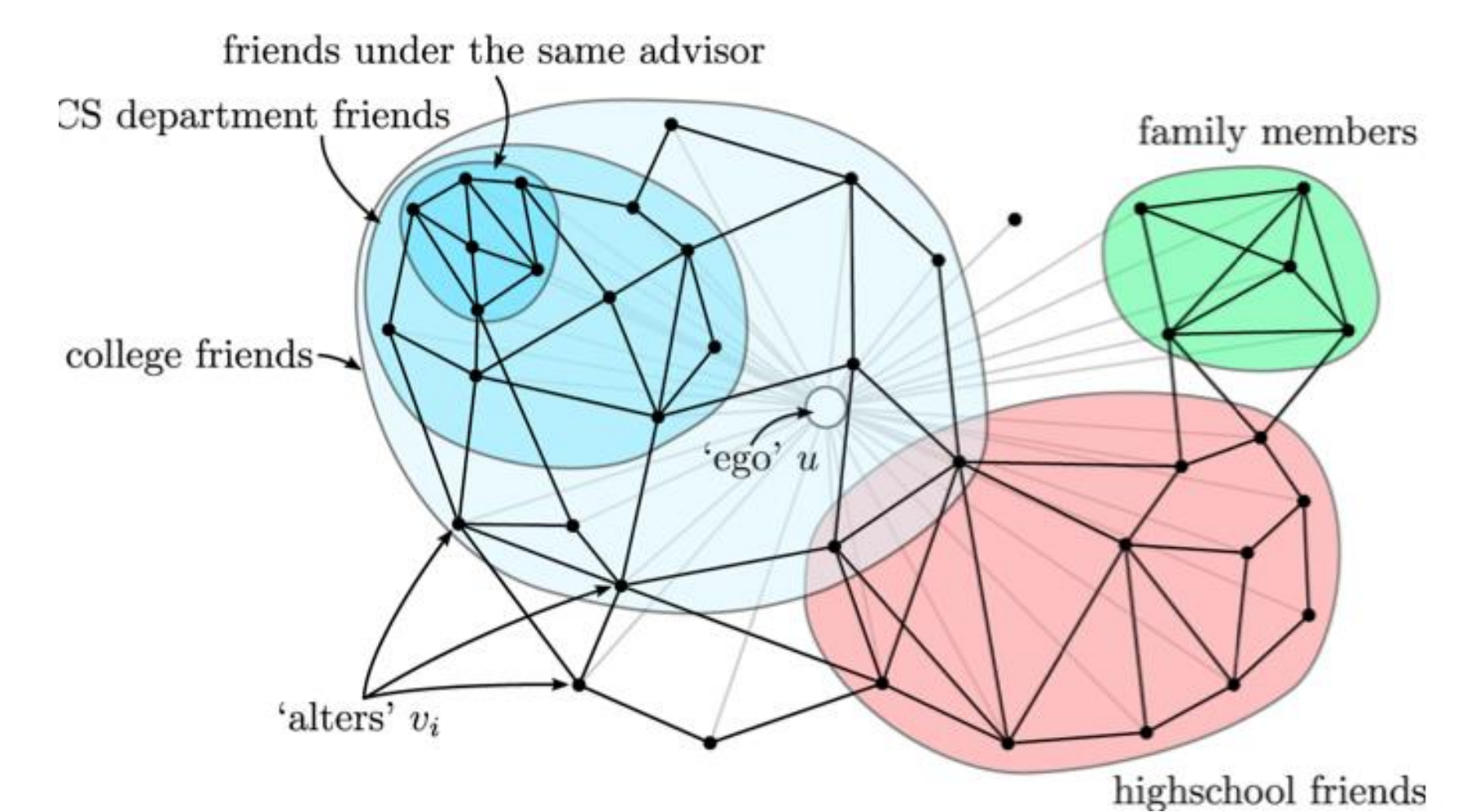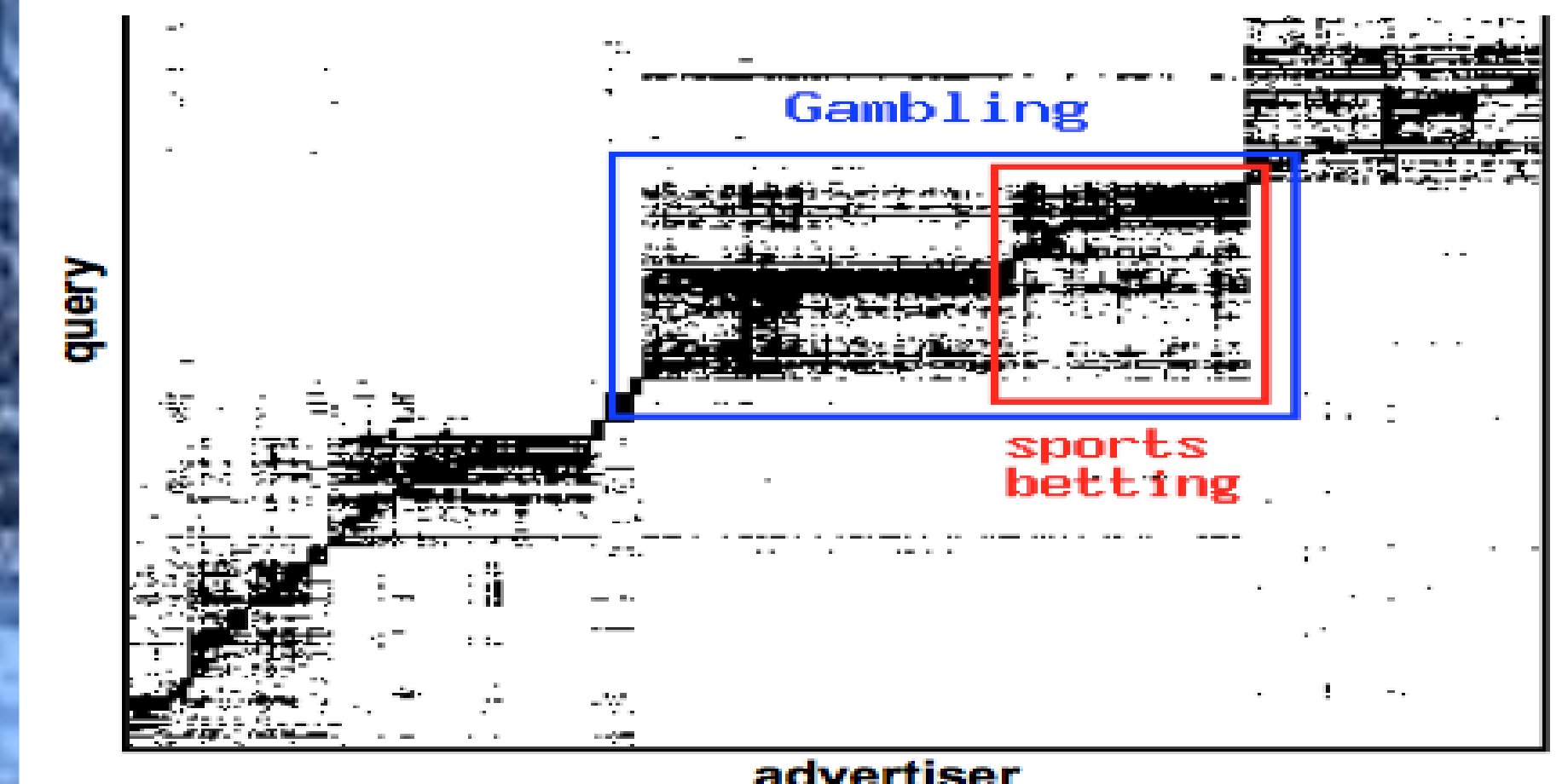
The goal of finding the most dense nodes is also underway in many other areas such as marketing and advertisement. As the top graph shows the action of gambling and how much it takes place and breaks that down into not only gambling, but what types of gambling is taking place, and in this example it is Sports betting. The second figure shows social circles and connections between people on Facebook, linking friends, family, classmates and more.

Conclusion

(a) Step 1   (b) Step 2

(c) Step 3   (d) Step 4
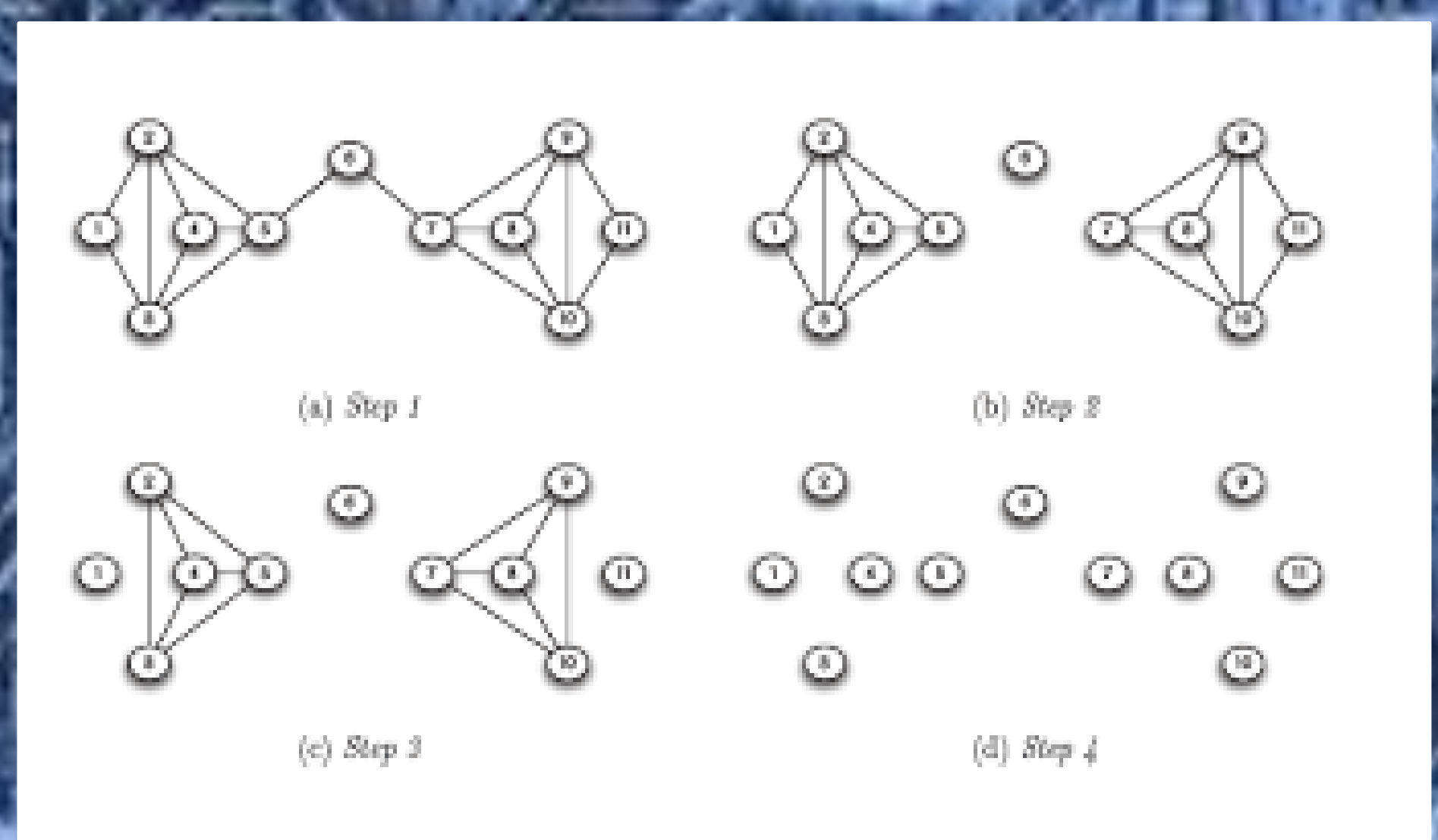
The algorithm's steps for community detection are summarized below

1. The betweenness of all existing edges in the network is calculated first.
2. The edge with the highest betweenness is removed.
3. The betweenness of all edges affected by the removal is recalculated.
4. Steps 2 and 3 are repeated until no edges remain.