Indian Journal of Engineering

ANALYSIS

International Journal for Engineering
ISSN 2319 – 7757 EISSN 2319 –7765

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Publication History
Received: 11 July 2015
Accepted: 16 August 2015
Published: 1 September 2015

Citation
Saravanan S, Sabari A. Community network – a novel concept in formation. *Indian Journal of Engineering*, 2015, 12(30), 219-228

COMMUNITY NETWORK – A NOVEL CONCEPT IN FORMATION

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Abstract

The goal of risk community selection in network is attempted with a different perspective in prioritizing risk selection with the course of action modelled on code sourced community network. This proposes a model that supports efficient risk prioritization on large networks. A new code sourced algorithm, the community network is systematized through postal index numbers and is implemented to accomplish the target. The code sourced community approach is effective and efficient on several counts such as collection and storage of data and computation complexity.

Key words:

Community, large network, code sourced algorithm

1. INTRODUCTION

The most recent wave of deliberation in the properties of networks of many kinds have thrusts in as diverse fields as internet, World Wide Web, citation networks, transportation networks, software call groups, email networks, food webs and social and biochemical networks (Newman 2003). Many complex systems can be represented as networks, where the elementary parts of a system and their mutual interactions are nodes and links described by Lancichinetti & Fortunato (2010). Complex systems are usually organized in compartments which have their own roles and functions. In the network representation, such compartments appear as sets of nodes, with a high density of internal links and a comparatively lower density in links between compartments. These subgroups are called communities or modules and occur in a wide variety of networked systems.

1.1 COMMUNITY – A FEW DEFINITIONS

Community is defined in several ways as exemplified in Fig.1.

- A community is a number of representative authority nodes linked by an important node that shares a common node.
- A community is a highly linked bipartite sub-graph and has at least one core containing complete bipartite sub graph.
- A set of nodes that links more nodes in the community than those outside the community could be defined as a sub community.
- A research community could be based on a single most node and contains all nodes that link it.

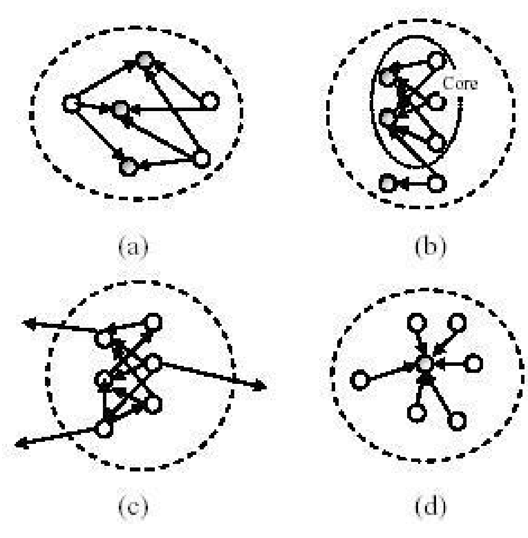

Figure 1 Delineations of Community

While each of the above definitions characterizes some essential properties of a community, it makes the community mining task rather demanding because of the absence of a standardized definition.

2. COMMUNITY REVELATION

Identification and analysis of compartments or communities yield knowledge on the organization of complex systems and their functions. Therefore detecting communities in networks has become a fundamental problem in network science (Geetha, 2014). Many methods have been developed, using tools and techniques from disciplines like physics, biology, applied mathematics,

computer and social sciences. However, it is not clear which algorithms are reliable and shall be used in applications. The question of the reliability itself is tricky as it requires the shared definitions of community and participation which are present still missing. This essentially denotes that, despite the voluminous research and findings in the field, there is still no consensus among the researchers on what a network with communities looks like.

Community or modular structure is considered to be a significant property of real-world social networks as it often accounts for the functionality of the system. Despite the ambiguity in the definition of community, numerous techniques have been developed for both efficient and effective community detection. Random walks, spectral clustering, modularity maximization, differential equations, and statistical mechanics have all been used earlier. Much of the focus within community detection has been on identifying disjoint communities described by Danon et al(2005).

However, it is well-understood that people in a social network are naturally characterized by multiple community memberships. For example, a person usually has connections to several social groups like family, friends, and colleagues; a researcher may be active in several areas. Further, in online social networks, the number of communities an individual could belong to is essentially unlimited because a person can simultaneously associate with as many groups as he wishes. This also happens in other complex networks such as biological networks, where a node might have multiple functions. In Kelley et al (2011) and Reid et al (2011), the authors showed that the overlap is indeed a significant feature of many real-world social networks.

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3. CRUCIAL CONCEPTIONS IN COMMUNITY SIGHTING

Some basic concepts and details of community detection are essential before an endeavor is made in understanding its application in real life networks.

- Given a network or graph $G = \{E, V\}$, V is a set of n nodes and E is a set of m edges.
- For dense graphs, $m= O(n2)$, but for sparse networks $m= O(n)$.
- The network structure is determined by the $n \times n$ adjacency matrix A for an unweighted networks and weight matrix W for

weighted networks.

- Each element A_{ij} of A is equal to 1 if there is an edge connecting nodes i and j; and it is 0 otherwise.
- Each element w_{ij} of W takes a non negative real value representing strength of connection between nodes i and j.
- In the case of overlapping community detection, the set of clusters found is called a *cover* $C = \{c1, c2, . . . ,ck\}$ Lancichinetti et al(2009), in which a node may belong to more than one cluster.
- Each node i associates with a community according to a *belonging factor* (i.e., soft assignment or membership) $[ai_1, ai_2, . . . ,ai_k]$ Nepusz et al(2008), in which $ai_c$is a measure of the strength of association between node i and cluster c. Without loss of generality, the following constraints are assumed to be satisfied

$$0 \le ai_c \le 1 \; \forall i \in V, \forall_c \in C \; and \; \sum_{c=1}^{|c|} ai_c = 1 \qquad (3.1)$$

Where$|C|$ is the number of clusters. However, the belonging factor is often solely a set of artificial weights. It may not have a clear or unambiguous physical meaning in Ren et al(2009).

In general, algorithms produce results that are composed of either of the two types of assignments, crisp (nonfuzzy) assignment or fuzzy assignment (Gregory 2011). With crisp assignment, the relationship between a node and a cluster is binary. That is, a node i either belongs to cluster c or does not. With fuzzy assignment, each node is associated with communities in proportion to a belonging factor. With a threshold, a fuzzy assignment can be easily converted to a crisp assignment. Most detection algorithms give outputs as crisp community assignments.

4. ALGORITHMS FOR COMMUNITY DISCOVERY

Algorithms have been developed to identify the communities and their inter relationships. Some of these algorithms are listed below.

- Algorithm of Girvan and Newman
- Fast greedy modularity optimization by Clauset, Newman and Moore
- Exhaustive modularity optimization via simulated annealing
- Fast modularity optimization by Blondel et al (2008)
- Cfinder
- Markov cluster algorithm
- Structural algorithm by Rosvall and Bergstrom
- Dynamic algorithm by Rosvall and Bergstrom
- Spectral algorithm by Donnetti and Munoz
- Expectation-maximization algorithm by Newman and
- Leicht Potts model approach by Ronhovde and Nussinov

Some of these and the following algorithms are exclusive overlapping community detection algorithms.

- Clique percolation
- Line graph and link partitioning
- Local expansion and optimization
- Fuzzy detection
- Agent based and dynamical algorithms

5. COMMUNITY SOURCED NETWORK

Community means a group of similar nodes. Boulevard network $G = (\mathrm{V}, \mathrm{E})$ combine with fuzzy weighted adjacency matrix and give the result $G = (\mathrm{V}, \mathrm{E}, W)$. A community is based on knowledge of cities. V is the set of cities (nodes), E is the set of roads (edges) and W is the road risk factor weight. Every vertex has the knowledge of Pin-code, Zip code, Mobile code, Locality, Longitude and Latitude. Landmarks are the basic foundation on which great communities are built. The code-base of community in this exercise is instituted on India's postal codes, Postal Index Number or PIN. These pin-codes are a numeric sequence of six digits, first three digits denote the state and the district and the last three digits represent the post office of a specific place. Cities having the same first three digits in their pin codes form a community. Distinct district forms a community or a sub graph. Nodes in different communities that have a path among one other lie on the border of respective communities. The nodes within a community that are connected with each other are called with-in community. The group of those nodes lie on the borders of different communities that are connected to each other is called between communities.

6. SAMPLE NETWORK

Step 1: large code source network

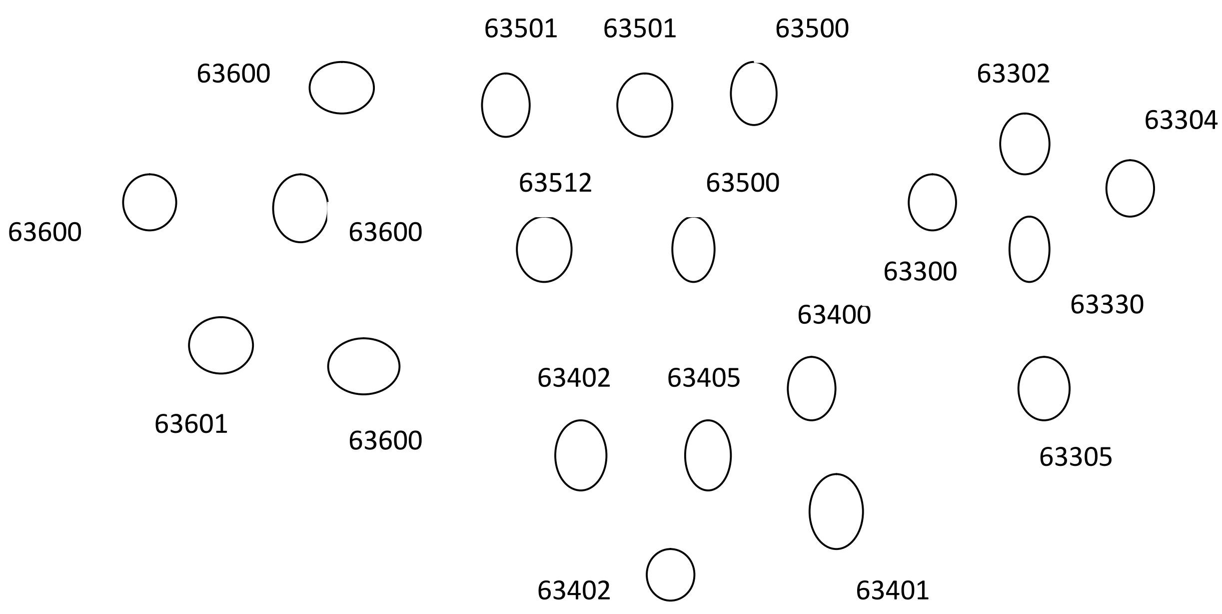

Figure 2 Large network

Step 2: The large network $G = (V, E)$ V is the vertices and E is Edges. This community follows first three digits in the code.

Step 3: **Finding the border node**

Same community grouped with dashed line and different community grouped with solid line

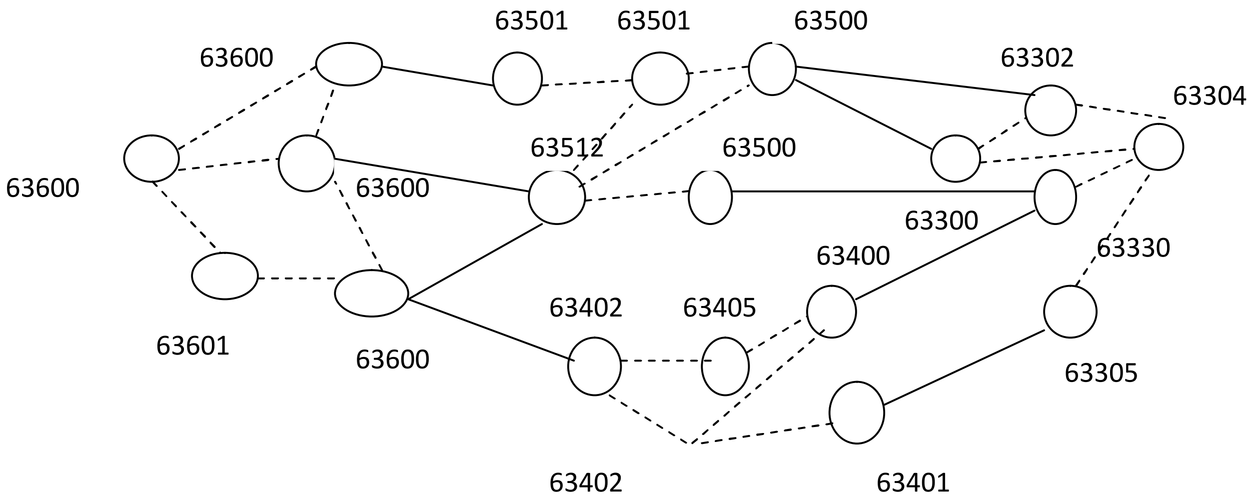

Figure 3 Border node identification

Step 4: Bounded network formation

Based on intercommunity it forms high level community network.

$$InterCOMMU(Gu', Gv') = \{\langle i, j\rangle \in BE \cdot \cdot ifUi \neq Vj \wedge (i \in Border(Gu')) \wedge (j \in Border(Gv'))\}$$

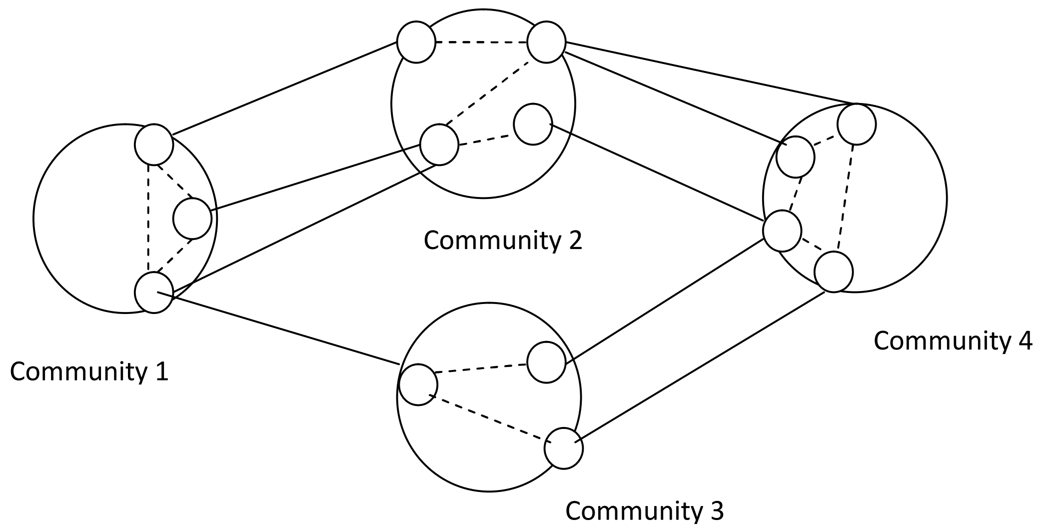

Figure 4 Bounded network formations

7. CONCLUSION

A design of the proposed work with the aim and methodology, the historical perspective of the current dimension of research and the two important aspects of large networks, risk dynamics and code sourced community network, form the bounded network. The spotlight now shifts to the application of RFID and Fuzzy AHP in large road networks.

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