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Collaboration Network Analysis Based on Normalized Citation Count and Eigenvector Centrality

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ABSTRACT

In the research community, the estimation of the scholarly impact of an individual is based on either citation-based indicators or network centrality measures. The network-based centrality measures like degree, closeness, betweenness & eigenvector centrality and the citation-based indicators such as h-index, g-index & i10-index, etc., are used and all of the indicators give full credit to all of the authors of a particular article. This is although the contribution of the authors are different. To determine the actual contribution of an author in a particular article, we have applied arithmetic, geometric and harmonic counting methods for finding the actual contribution of an individual. To find the prominent actor in the network, we have applied eigenvector centrality. To authenticate the proposed analysis, an experimental study has been conducted on 186007 authors collaboration network, that is extracted from IEEE Xplore. The experimental results show that the geometric counting-based credit distribution among scholars gives better results than others.

KEYWORDS

Collaboration Network, Eigenvector Centrality, Normalized Citation Count, Social Network

1. INTRODUCTION

In the research community, the collaboration between researchers plays an important role to develop a new technology. It may span over multiple subject areas, multiple organization or country. But one of the major tasks is to estimate the scholarly impact of individual and discovered the most prominent actor in the whole network as well as in a particular community. For this, several analyses and research are done by eminent researchers and much research and analyses are currently ongoing. Several bibliometric indicators and social network analysis metrics were proposed to estimate the scholarly impact of individual and for finding the key author in the community. In general, it seems that all of the indicators consider full credit of an article, but rarely the contribution of all authors are equal. To share or distribute the citation of an article to all authors is one of the major tasks. De Solla Price, (1981) mentioned that the contribution of all authors is equal, then the credit share of each author is 1/k. Where k is the total number of authors. However, hardly they contribute equally. Thus, it is not fair to share credit equally among all authors. Egghe et al., (2000) and Wan et al.

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(2007) used geometric series to distribute credit among authors in the multi-author article. TRuenba and Guerrero (2004) discuss the arithmetic counting and Hagen, (2008) discusses the harmonic counting to distribute share credit among authors. To evaluate the scientific impact of an individual not only the actual contribution is important, the neighbors' researcher is also playing an important role. To consider the impact of neighbors' researchers, the network-based centrality measures can be used. The network centrality measures like degree, closeness, betweenness, and the eigenvector centrality are generally used. The degree centrality considers only the number of connected authors, closeness considers how many neighbors are in the average distance, betweenness considers how many communications happens through the particular nodes and eigenvector centrality consider the total numbers of neighbors as well as the impact of the neighbors' node. So, the eigenvector centrality is more suitable than others for calculating the impact of a node in the collaboration network. In this paper, our prime objective is to discover the most influenced actor in the network. For this first, we discuss the arithmetic, geometric and harmonic counting methods for finding the actual contribution of the individual author of an article. After that, the eigenvector centrality is used for scientific assessment of authors and also used for discovering the prominent author in the network. To do this, first, we set the initial impact of every node is the total share credit of individual from all articles and the collaboration weight is the correlation coefficient based on the normalized citation count by different counting methods.

2. RELATED WORK

Newman (2001) discussed the weighted collaboration network of co-authors. Here, authors mentioned that the node represents the individual author and the edge between nodes represents the collaboration and the weight of the edge represents the collaborative strength. Farkas et al. (2007) discussed the weighted collaboration network for appraising the scholarly impact of authors where weight is the geometric mean of citation count earn by the collaborators.

Abbasi et al. (2011) discuss the weighted collaboration of researcher and used social network analysis metrics to evaluate the scientific impact of individuals. In this article, the author used the total number of publications as a collaboration weight between collaborators.

Wang et al. (2011) discuss the weighted co-authorship network and used component analysis, publication frequency and degree centrality for finding the prominent actor in the network.

Liu et al. (2005) formed the collaboration network of digital library research community and proposed a new method for evaluation of the scientific impact of an individual called author rank and mentioned that this method gives a better result than social network analysis metrics. In this article author, consider the sum of the proportional counting of the total number of authors excluding self in a particular paper as a collaboration weight.

Liu et al. (2015) discuss the new method to construct a collaboration network. Here author used geometric series for calculation of share credit to all authors in a particular paper and the collaboration weight computed based on the law of gravity.

Bihari et al. (2015) discuss the citation count weighted network of collaboration network and convey the social network analysis metrics like degree centrality, closeness centrality, betweenness centrality & eigenvector centrality and citation-based indicators like h-index, g-index and i10-index for prominent actor finding.

Bihari et al. (2015) discussed the eigenvector centrality and its application in the collaboration network. In this article, the author used the degree centrality of the node as an initial impact of a node and the collaboration weight is the total number of citation count earned by all those publications which were published together.

Bihari et al. (2016) implements the maximum spanning tree to remove all those edges which has less impact in their research and find out the most influential actor in the community by using centrality measures.

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