

# Who are the Rising Stars in Academia?

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## ABSTRACT

This paper proposes a novel method named ScholarRank to evaluate the scientific impact of rising stars. Our proposed ScholarRank integrates the merits of both statistical indicators and influence calculation algorithms in heterogeneous academic networks. The ScholarRank method considers three factors, which are the citation counts of authors, the mutual influence among coauthors and the mutual reinforce process among different entities in heterogeneous academic networks. Through experiments on real datasets, we demonstrate that our ScholarRank can efficiently select more top ranking rising stars than other methods.

## Keywords

Rising star; Heterogeneous networks; HITS; PageRank

## 1. INTRODUCTION

The success of academic career not only depends on researcher's personal capacity, but also closely relates to the supports from both governments and institutions. This drives the emergence of more and more research achievements on evaluating the scientific impact of scholars, because it can provide basis for foundation application etc. However, on the contrary, little efforts have been devoted to quantifying the future potential of academic new talents. Therefore, we propose a novel method based on heterogeneous academic networks to find potential academic new talents, which are known as rising stars.

In our paper, rising stars refer to scholars who are not outstanding among peers or with low research profiles at the beginning stage of their scientific career, but tend to become influential researchers in the future. Currently, the existing approaches for the evaluation of rising stars generally ignore a vital fact [1], which is the mutual reinforce process among the components of academic networks. Most of previous studies only consider the mutual influence among coauthors and use homogeneous networks for evaluation. However, as a matter of fact, the real academic networks consist of

various kinds of entities and links. Therefore, it is essential to evaluate the impacts of rising stars under heterogeneous networks. In addition, the reputations of scholars are mainly represented by their publications, while on the contrary, the qualities of publications are also affected by the capacities of its authors. As a consequence, when evaluating the impacts of rising stars, the mutual reinforce process among scholars, articles and corresponding venues should also be considered.

In this work, inspired by the facts mentioned above, we propose a novel method called ScholarRank to evaluate the scientific impact of rising stars. In order to measure the mutual influence among coauthors, we first compute the value of our proposed indicator as introduced in [2]. Then we use our hybrid algorithms to depict the mutual reinforce process among different entities in academic networks. Finally, we apply our proposed ScholarRank on real datasets to evaluate the impacts of rising stars, the architecture of ScholarRank is shown in Figure. 1.

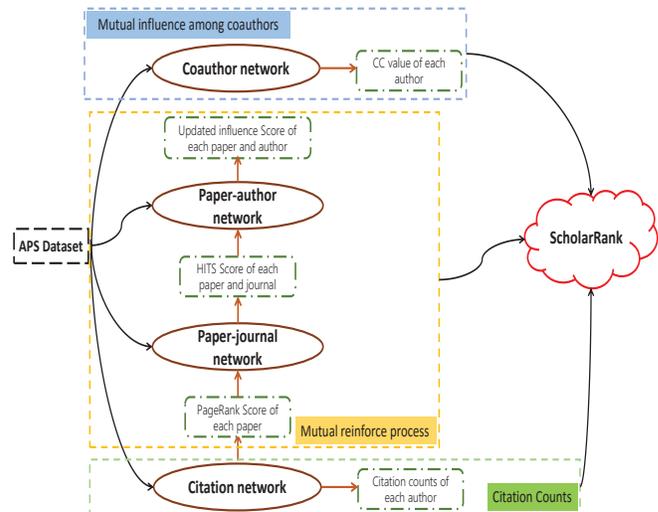


Figure 1: Architecture of ScholarRank.

## 2. SCHOLARRANK METHOD

### 2.1 The mutual influence among coauthors

In order to measure the mutual influence among coauthors, we use the indicator named the caliber of collaboration (CC) to capture the researchers' capacity of collaborating with scholars from diverse backgrounds as we proposed

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in [2], because scholars can benefit a lot by cooperating with diverse scholars. The specific method is illustrated as follows.

$$entropy(a_i^t) = - \sum_{\vartheta=1}^r w_{\vartheta}^t \log_2(w_{\vartheta}^t) \quad (1)$$

$$CC(a_i) = \sum_{t=1}^u entropy(a_i^t) \quad (2)$$

where  $a_i$  represents an author,  $r$  is the total number of the words in all the institutions' information of  $a_i$ 's cooperators in year  $t$ , and  $w_{\vartheta}^t$  is the possibility of word  $\vartheta$  in all the institutions' information of  $a_i$ 's cooperators in year  $t$ . The value of  $CC(a_i)$  is the sum of  $entropy(a_i^t)$  according to specific time intervals, where  $u$  refers to the time intervals as we set.

## 2.2 Mutual reinforce process in heterogeneous academic networks

In this paper, our hybrid algorithms on measuring the importance of nodes are applied in order to measure the mutual reinforce process in heterogeneous academic networks, which compose of three sub-networks, i.e. citation network, paper-journal network and paper-author network. We first compute the importance of papers under citation network according to PageRank algorithm.

Then we consider the mutual reinforce process between papers and corresponding journals to measure the influence of journals. The HITS algorithm is applied to calculate the influence of journals in paper-journal network. In the initial step, if the node is a paper, the values of it are set equal to the PageRank score we get under citation network, else we set the initial value equal to 1.

After the calculations in paper-journal network, we can get the new impact scores of papers and journals. We then measure the influence of authors also according to HITS algorithm in paper-author network. In the initial step, if the node is a paper, the values of it are set equal to the influence score we get in paper-journal network, else we set the initial values as 1. Then we can get the final influence score of authors by considering the mutual reinforce process between papers, journals and authors in heterogeneous academic networks.

## 2.3 Calculation of ScholarRank

In our proposed ScholarRank, it contains three main parts, which are citation counts, value of CC and our hybrid algorithms in heterogeneous academic networks. The following equation is used to calculate the final score of authors:

$$ScholarRank(a_i) = \frac{1 - \alpha - \beta - \delta}{n} + \alpha \frac{CC(a_i)}{T_{CC}} + \beta \frac{Cita(a_i)}{T_{Cita}} + \delta \frac{auth(a_i)}{T_{hyb}} \sum_{j=1}^{\varpi} con(a_i^j) PR(j) auth(V_j) \quad (3)$$

where  $\alpha$ ,  $\beta$  and  $\delta$  are parameters,  $\varpi$  is the number of total papers written by author  $a_i$  and  $n$  is the number of authors in the network.  $Cita(a_i)$  is the total citation counts of author  $a_i$  and  $T_{Cita}$  is the total citation counts of all the authors.  $T_{CC}$  is the total CC values of all the authors.  $con(a_i^j)$  means  $a_i$ 's contribution in paper  $j$  and we set it as  $1/\theta$  for simplicity, where  $\theta$  is the order of  $a_i$  in paper  $j$ .  $PR(j)$  is paper  $j$ 's PageRank score in citation network,  $auth(V_j)$

is the corresponding venue's impact score in paper-journal network and  $auth(a_i)$  is the influence score of author  $a_i$  in paper-author network.  $T_{hyb}$  is the total values of the hybrid results by all the authors.

## 3. EXPERIMENTS AND RESULTS

We use datasets from American Physical Society and select authors beginning their scientific careers at the year of 1993. We compare ScholarRank with the following methods to evaluate its effectiveness. **CocaRank** is proposed in [2] and **StarRank** is introduced in [3], we choose these two methods for comparison.

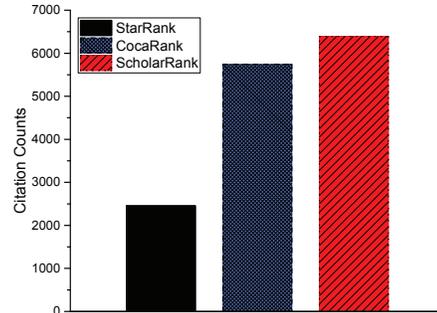


Figure 2: Comparison of average citation counts.

The time intervals we select for evaluation is the initial 5 years of researchers' scientific careers. We assume that the higher citation counts a scholar gets, the more influential he is. In order to validate the performance of our proposed ScholarRank method, we compute the top 10 rising stars' average citation counts in 2013 by our ScholarRank and the above comparison methods. As shown in Fig. 2, the ScholarRank achieves the highest average citation counts among all the comparison methods, and it indicates that our proposed ScholarRank can efficiently select top ranking researchers than other methods.

## 4. CONCLUSIONS

In this paper, we propose the ScholarRank method to evaluate the impact of rising stars, and the experiments on real datasets indicate that our method can find more top ranked rising stars than other methods. In future work, we will test the performance of ScholarRank on more datasets and consider more factors which correlate with the influence of scholars, such as the social relations of scholars, and the download times of papers.

## 5. REFERENCES

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