系统科学学院月报

2015 年第 4 期（总第 11 期）　　2015 年 7 月 15 日

学科建设

◆ 一、狄增如教授受聘国务院学位委员会学科评议组召集人

日前，国务院学位委员会批准并公布了第七届学科评议组成员名单，北京师范大学共有 20 位教授受聘，涉及 19 个学科评议组，其中 8 位教授为所在学科评议组召集人。系统科学学院院长狄增如教授受聘为系统科学组系统理论学科评议组召集人。

◆ 二、著名书法家王树民为系统科学学院题词

6 月 24 日上午，我院在北京师范大学京师科技大厦举行交接仪式，接受了著名书法家王树民先生为学院题写的院训。系统科学学院院长狄增如在交接仪式上致辞，感谢王树民先生对系统科学学科建设的关心与支持。交接仪式由系统科学学院副院长蔡明智主持。

王树民，字子牛，民革党员。十五岁拜著名书法家朱复戡、孟庆甲先生学习书法。沙孟海先生见其指书曾赞曰："师宗各家成新势，指走龙蛇任纵横"。 其作品曾作为礼品赠给泰国亲王、台湾领导人马英九、宋楚瑜及各界友人，作品堪称一部书法艺术发展史，畅销世界各国。现为中国书法家协会会员、世界华商书画院副院长、深圳名人书画院副院长。

人才培养

- ◆ **一、祝贺赵琛等3名同学获得系统理论专业博士学位，周怡宸等7名同学获得系统理论专业硕士学位，王馨等2名同学获得系统工程专业硕士学位，李乐等19名同学获得项目管理领域工程硕士学位。**

6月20日，学校召开了学位委员会全体会议，表决通过了全校学位授予名单。系统科学学院赵琛、代文杰、李耕3名同学获得系统理论专业博士学位；周怡宸、齐天笑、贺得力、周梦宇、齐征、董灿、姚丽阳7名同学系统理论专业硕士学位；王馨、吴畏2名同学获得系统工程专业硕士学位，李乐、崔哲、李通、辛华、王宝奇、冯林、王晓莉、郝晨星、郭念、魏丽萍、杨琨、陈丽娜19名同学获得项目管理领域工程硕士学位。

赵琛同学获北京市优秀毕业生，姚丽阳同学获北京师范大学优秀毕业生。

周梦宇同学因支援西部建设受到北京师范大学嘉奖。

陈丽娜、张静、赵佳、王潇炜、杨鹰军的学位论文被评为2015年北京师范大学项目管理领域工程硕士优秀学位论文。

向上述同学表示祝贺！

- ◆ **二、我院召开2015届研究生毕业生座谈会**

作为毕业生教育和交流的重要环节，6月26日，系统科学学院组织召开2015届研究生毕业生座谈会，李红刚书记、狄增如院长、韩战钢副院长，部分教师与研究生毕业生代表15人进行了面对面的交流，为毕业生送上祝福的同时，也听取了毕业生对学院教学、管理、服务等方面的意见和建议。

座谈会上，同学们表达了对学院、导师的感激和不舍，对学院未来的发展充满期待和信心。系统科学学院像个大家庭，大家认为最为幸运的就是能够在学院老师的关爱和教导下度过美好的校园时光，老师们谦虚谨慎的工作态度，以及对科研的执着追求对同学们产生了潜移默化的影响。自2014年独立建院以来，同

学们见证了学院的快速发展，并以身为系统学子而骄傲。同学们在表达感激和不舍之情的同时，还积极进言献策，围绕学科建设、品牌推广、学生活动、就业指导、国际交流等话题畅谈自己的想法和建议，并希望学院能够搭建研究组学生之间交流沟通的平台，这些建议对学院未来的发展很有帮助。

最后，韩战钢副院长感谢毕业生对学院和学科建设工作的支持，狄增如院长对毕业生们提出了殷切的期望，祝愿他们都能在未来的事业发展中有所建树，为社会创造财富，实现个人价值。李红刚书记则鼓励大家在未来的工作岗位上积极进取、踏实勤奋、团结协作，也希望大家能够继续关注学院，积极参加院友会的活动，与母校保持联系，在不同的岗位上都能够为学院的发展和建设贡献自己的一份力量。

科学研究

◆ **一、我院与河南省许昌市魏都区教育体育局签署"教育文化大数据"合作共建项目**

2015 年 5 月 30 日上午，北京师范大学系统科学学院与河南省许昌市魏都区"教育文化大数据"项目课题共建签约仪式在北师大京师科技大厦举行。北师大系统科学学院院长狄增如、副院长蔡明智、魏都区政府副区长李洁、魏都区教体局局长刘建涛、许昌市教师进修学校副校长纪国哲等领导及教育文化大数据课题组、课题合作单位相关人员参加了签约仪式。北师大系统科学学院院长狄增如、魏都区政府副区长李洁、魏都区教体局局长刘建涛和分别在签约仪式上讲话。系统科学学院副院长蔡明智主持了签约仪式。

北师大系统科学学院与教育部教育发展研究中心承担着国家教育国际化战略研究以及教育文化大数据建设的科研任务。教育文化大数据中心的建设，作为学科交叉和科研创新的重要平台，将致力于利用系统科学的思想和方法发展大数据采集、存储、传输和分析技术，挖掘大数据中的教育、学习行为与规律，为推进教育信息化打下基础。

◆ **二、我院师生应邀参加计算经济与金融国际会议**

2015 年 6 月 20-22 日，第 21 届计算经济与金融国际会议（21st Computing in Economics and Finance）在台北举行，来自世界各地的 300 余名学者参加了会议。该会议每年举行一次，是计算经济与金融领域的国际盛会。我院李红刚教授、陈清华副教授，研究生周璇和张扬锐，以及本科生幸小芸参加了会议并分别作了报告。

报告的题目分别是："Financial Systemic Risk Based on Liquidity Dynamic Allocation in Interbank Network"，"A Multi-Agent Model For Lowest Unique Bid Auction"，"Buying on Margin, Selling Short in an Artificial Double Auction Market"，"The Research of Investor's Social Network and the Volatility of Market Price"和"Local Network Effect and Competition Model"。

◆ **三、我院吴金闪副教授参加加拿大物理学年会**

2015 年 6 月 19 日，加拿大物理学年会（CAP Congress 2015）在 Edmonton 召开。会上，我院吴金闪副教授做题为"Which subfield of physics is more influential? "的邀请报告。

◆ 四、近期科研成果汇总

1. Fuguo Zhang and An Zeng*, Information Filtering via Heterogeneous Diffusion in Online Bipartite Networks, [Plos One 10(6), e0129459 (2015)]

简介：

推荐系统是一种有效的信息过滤手段。在经典的协同过滤算法的基础上，近年来一些基于经典物理扩散过程的算法能有效的提高推荐的精度和多样性。在用户-商品二分网中，用户节点和商品节点的结构统计特性有很大差别，这就要求推荐算法在从商品至用户方向和用户至商品方向使用不同的扩散过程。基于这个想法，本文研究了经典的热传导和物质扩散耦合算法，通过计算得到了此算法在二分网两个扩散方向的最优参数。结果显示两个扩散方向的最优参数显著不同，并且在各个扩散方向上分别使用最优参数能进一步同时提高推荐的准确性和多样性。

The rapid expansion of Internet brings us overwhelming online information, which is impossible for an individual to go through all of it. Therefore, recommender systems were created to help people dig through this abundance of information. In networks composed by users and objects, recommender algorithms based on diffusion have been proven to be one of the best performing methods. Previous works considered the diffusion process from user to object, and from object to user to be equivalent. We show in this work that it is not the case and we improve the quality of the recommendation by taking into account the asymmetrical nature of this process. We apply this idea to modify the state-of-the-art recommendation methods. The simulation results show that the new methods can outperform these existing methods in both recommendation accuracy and diversity. Finally, this modification is checked to be able to improve the recommendation in a realistic case.

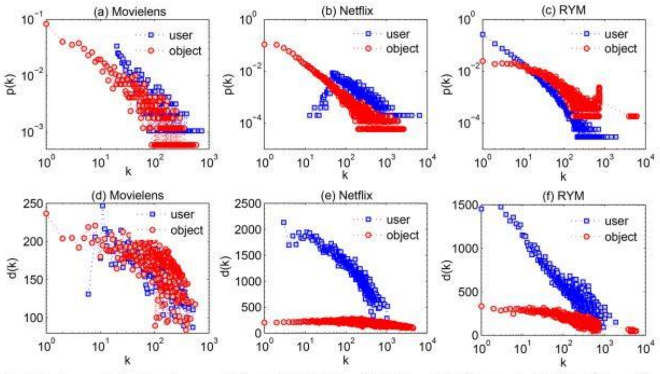

Fig 1. The degree distribution of users and objects in (a) Movielens, (b) Netflix and (c) RYM networks. (d), (e) and (f) are $d(k)$ vs k in Movielens, Netflix and RYM networks, respectively. For the blue curve, k denotes the degree of users and $d(k)$ denotes the average degree of the neighboring objects of these users. For the red curve, k denotes the degree of objects and $d(k)$ denotes the average degree of the neighboring users of these objects.

doi:10.1371/journal.pone.0129459.g001

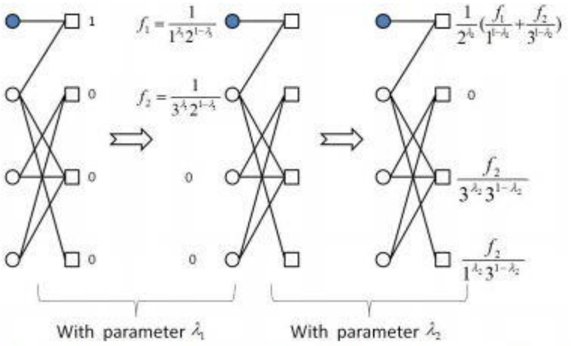

Fig 2. The illustration of the H-Hybrid method. Users and items are marked with circles and squares, respectively. Shaded circles indicate the target user for whom recommendation is done.

doi:10.1371/journal.pone.0129459.g002

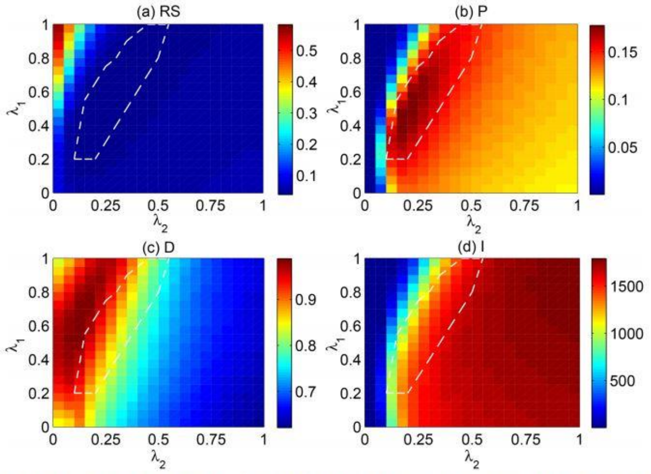

Fig 3. The (a) Ranking score, (b) Precision, (c) personlization and (d) novelty of the H-Hybrid method in parameter space (λ_1, λ_2) in Netflix network. The dashed line marks the region where RS is better than the RS value achievable with O-Hybrid method.

doi:10.1371/journal.pone.0129459.g003

2. Hao Liao, An Zeng* and Yi-Cheng Zhang, Predicting missing links via correlation between nodes, [Physica A 436, 216 (2015)]

简介：

链路预测是复杂网络研究中的一个热门问题。现有大部分链路预测算法都是通过对网络中节点相似程度的估算来实现连边预测，其基本思想是假设相似的节点之间更有可能在未来存在连边。与已有工作不同，本文提出可以通过皮尔逊相关系数来对于节点相似程度进行估算。结果显示，这种方法能有效去除高阶路径中的噪音信息，因此在稀疏网络上能达到较高的链路预测精度。

As a fundamental problem in many different fields, link prediction aims to estimate the likelihood of an existing link between two nodes based on the observed information. Since this problem is related to many applications ranging from uncovering missing data to predicting the evolution of networks, link prediction has been intensively investigated recently and many methods have been proposed so far. The essential challenge of link prediction is to estimate the similarity between nodes. Most of the existing methods are based on the common neighbor index and its variants. In this paper, we propose to calculate the similarity between nodes by the Pearson correlation coefficient. This method is found to be very effective when applied to calculate similarity based on high order paths. We finally fuse the correlation-based method with the resource allocation method, and find that the combined method can substantially outperform the existing methods, especially in sparse networks.

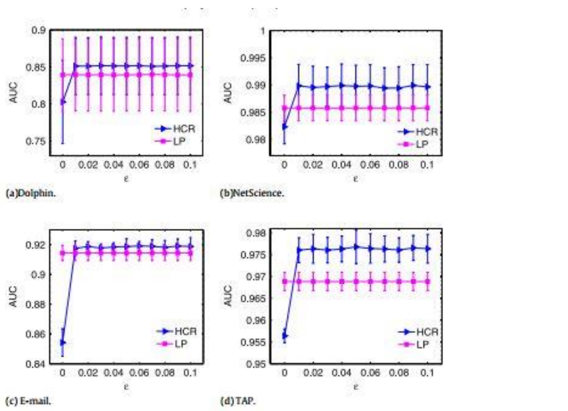

Fig. 2. (color online) The dependence of the AUC of the HCR method on ϵ in four real networks. The results of the LP method are shown for comparison. In the LP method, the parameter is chosen as $\epsilon = 0.01$ which is shown to be the optimal parameter for this method according to Ref. [24]. The error bars in this figure are obtained based on 10 independent realizations.

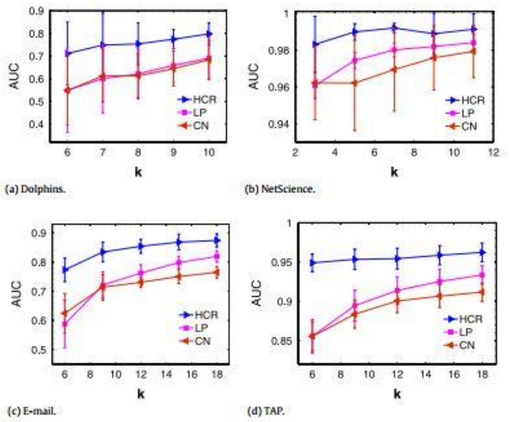

Fig. 3. (color online) The AUC of the probe set links connecting nodes with degree sum smaller than k when different link prediction algorithms are applied. In the LP method, the parameter is chosen as $\epsilon = 0.01$. In the HCR method, the parameter is chosen as $\epsilon = 0.001$. The error bars are obtained based on 10 independent realizations.

3. Alexandre Vidmer, An Zeng, Matus Medo, Yi-Cheng Zhang, Prediction in complex systems: The case of the international trade network, [Physica A 436, 188 (2015)]

简介：

国家-出口品网络是一种典型的二分网，连接两类节点之间的连边表示某个国家出口了某项商品。在现有工作中，很多迭代算法能对国家的竞争力和商品的复杂程度做出估算，但至今还没有特别好的算法能对此类网络中未来连边的预测（即国

家未来将出口哪些商品）。本文将一些经典的推荐算法运用到国家-出口品网络的预测中，通过用国家竞争力和商品复杂度指数对这些算法进行改进，进一步提高预测精度。此外，本文还提出了一个新的商品因果关系指数，并通过它对推荐算法进行改进，达到了最优的预测效果。

Predicting the future evolution of complex systems is one of the main challenges in complexity science. Based on a current snapshot of a network, link prediction algorithms aim to predict its future evolution. We apply here link prediction algorithms to data on the international trade between countries. This data can be represented as a complex network where links connect countries with the products that they export. Link prediction techniques based on heat and mass diffusion processes are employed to obtain predictions for products exported in the future. These baseline predictions are improved using a recent metric of country fitness and product similarity. The overall best results are achieved with a newly developed metric of product similarity which takes advantage of causality in the network evolution.

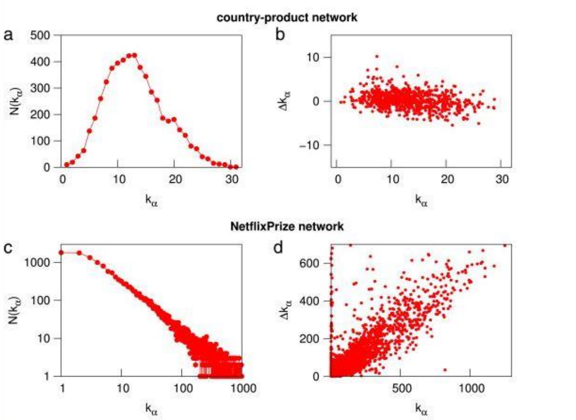

Fig. 1.
Panels (a) and (c) show the item degree distribution for the country-product network and the user-movie network, respectively. $N(k_\alpha)$ is the number of item of degree k_α. Panels (b) and (d) show the relation between item degree increase Δk_α between two time steps and item degree k_α. The time step is one year for the country-product network and two hundred days for the Netflix Prize network. Random displacements by values ranging from −0.5 to 0.5 along both axes were added to reduce the extent to which the symbols overlap.

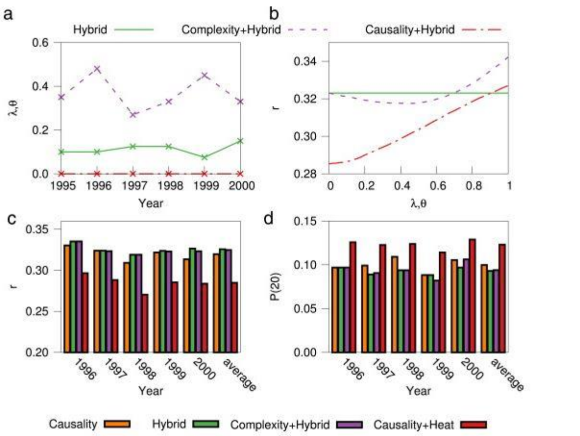

Fig. 4.
Panel (a) shows methods' optimal parameters at various years (optimization is again with respect to the ranking score). Panel (b) shows the dependence of the ranking score on the parameters for year 1998. The results of the optimized Hybrid method are shown for comparison. Results shown in (c) and (d) are made using the data in year 1995 and before to predict the new products in 1996. Methods' parameters are here fixed based on the optimal parameters of previous year's prediction. Performance of predictions based on causality is shown for comparison.

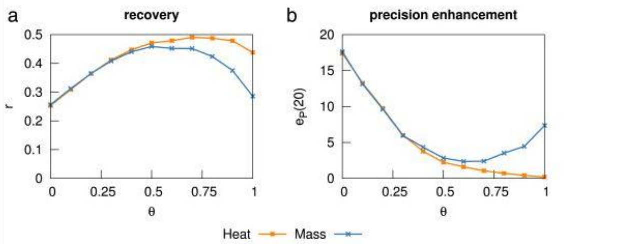

Fig. D.1.
Panel (a) shows recovery and panel (b) enhancement of precision compared to random predictions $e_P(20)$, for both the Mass and Heat diffusion recommendation methods as a function of the model parameter θ. The number of users is set to N=10,000, number of items to M=2000 and number of links to m=100,000.

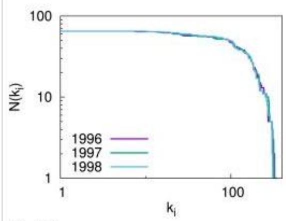

Fig. D.2.
The cumulative degree distribution of countries in the country-product network for three different years.

4. Hao Liao and An Zeng*, Reconstructing propagation with temporal similarity, [Scientific Reports 5, 11404 (2015)]

简介：

本文主要研究了传播网络的重构问题。与以往工作不同，本文使用经典的 SIR 传播模型。本文首先假设只有最终传播结果可知，而节点被感染的时间未知，在使用节点相似性对网络进行重构，发现大部分经典的相似性指标都能较好重构出传播网络。同时，我们发现若干相似性指标在重构网络时存在一些效果特别差的特殊参数区间。最后，我们将节点被感染时间信息加入经典的相似性指标，发现这种做法能大幅提高网络重构的精度。

Node similarity significantly contributes to the growth of real networks. In this paper, based on the observed epidemic spreading results we apply the node similarity metrics to reconstruct the underlying networks hosting the propagation. We find that the reconstruction accuracy of the similarity metrics is strongly influenced by the infection rate of the spreading process. Moreover, there is a range of infection rate in which the reconstruction accuracy of some similarity metrics drops nearly to zero. To improve the similarity-based reconstruction method, we propose a temporal similarity metric which takes into account the time information of the spreading. The reconstruction results are remarkably improved with the new method.

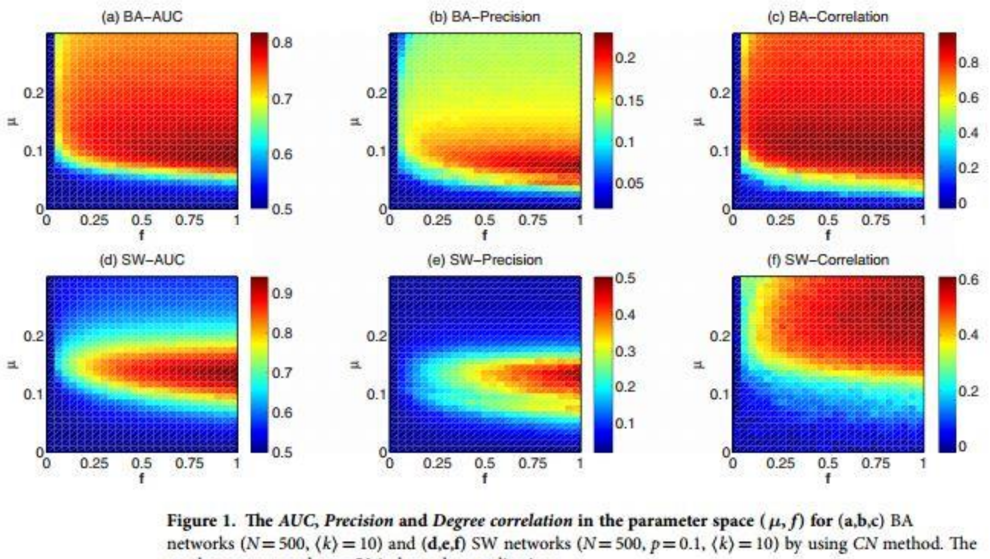

Figure 1. **The *AUC*, *Precision* and *Degree correlation* in the parameter space (μ, f) for (a,b,c)** BA networks ($N = 500$, $\langle k \rangle = 10$) and **(d,e,f)** SW networks ($N = 500$, $p = 0.1$, $\langle k \rangle = 10$) by using *CN* method. The results are averaged over 50 independent realizations.

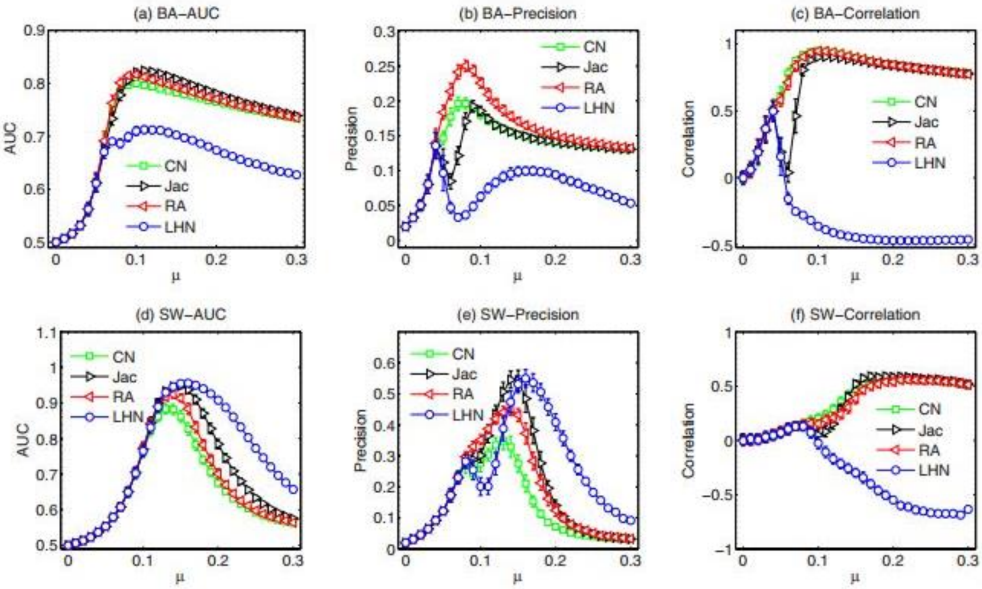

Figure 2. The dependence of the *AUC*, *Precision* and *Degree correlation* on μ with four different similarity methods in BA networks ($N = 500$, $\langle k \rangle = 10$) and (d,e,f) SW networks ($N = 500$, $p = 0.1$, $\langle k \rangle = 10$). We use $f = 0.5$ here. The results are averaged over 50 independent realizations.

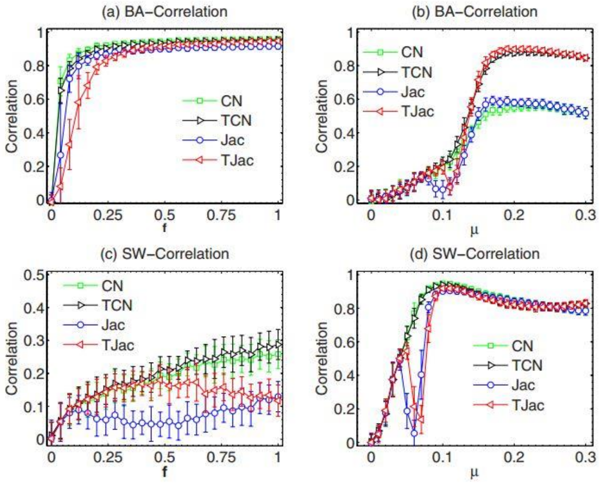

Figure 4. The dependence of *Degree correlation* on *f* with temporal similarity methods in BA and SW networks. We use $\mu = 1/\langle k \rangle$ in **(a)** and **(c)**, and $f = 0.5$ in **(b)** and **(d)**. The results are averaged over 50 independent realizations.

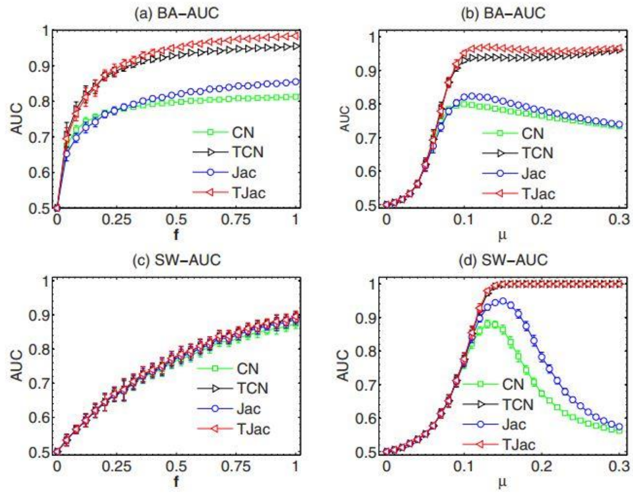

Figure 3. The dependence of the *AUC* on *f* with temporal similarity methods in BA and SW networks. We use $\mu = 1/\langle k \rangle$ in **(a)** and **(c)**, and $f = 0.5$ in **(b)** and **(d)**. The results are averaged over 50 independent realizations.

5. Sun, XY; Zhu, JF, Study of the shock wave induced by closing partial road in traffic flow, ACTA PHYSICA SINICA, 64(11), JUN 2015.

简介：

There often occurs traffic accident or road construction in real traffic, which leads to partial road closure. In this paper, we set up a traffic model for the partial road closure. According to the Nagel-Schreckenberg (NS) cellular automata update rules, the road can be separated into cells with the same length of 7.5 m. L = 4000 (corresponding to 30 km) is set to the road length in the simulations. For a larger system size, our simulations show that the results are the same with those presented in the following. In our model, v(max) denotes the maximum velocity of vehicle. Without loss of generality, we assume v(max 1) = 1 (corresponding to 27 km/h), where partial road is closed (for convenience, we define the road length as L-1), v(max 2) = 2 (corresponding to 54 km/h) in the section of normal road (we define the road length as L-2). In our simulations, let L-1 = L-2 = 2000. We would like to mention that changing these parameter values does not have a qualitative influence on the simulation results. The simulation results demonstrate that three stationary phases exist, that is, low density (LD), high density (HD) and shock wave (SW). Two critical average densities are found: the critical point rho(cr1) = 3/8 separates the LD phase from the SW phase, and rho(cr2) = 1/2 separates the SW phase from the HD phase. We also analyze the relationship between the average flux J and average density rho. In the LD phase J = 4/3 rho, in the HD phase J = 1 - rho and J is 0.5 in the SW phase. We investigate the dependence of J on rho. It is shown that with the increase of rho, J first increases, at this stage J corresponds to the LD phase. Then J remains to be a constant 0.5 when the critical average density rho(cr1) is reached, and J corresponds to the SW phase (this time, J reaches the maximum value 0.5). One goal of traffic-management strategies is to maximize the flow. We find that the optimal choice of the average density is 3/8 < rho < 1/2 in the present model. Similar road situation often occurs in everyday life, so the traffic managers can control the car density in order to alleviate the traffic congestion and enhance the capacity of existing infrastructure. After the second critical average density rho(cr2) is reached, J decreases with the increase of average density, which corresponds to the HD phase. We also obtain the relationship between the shock wave position and the average density by theoretical calculations, i.e. S-i = i + 4 - 8 rho, which is in agreement with simulations.

◆ 五、学术讲座

	主讲人	学术头衔	主持人	题目	时间	地点
1	Angel Sánchez	Professor of Universidad Carlos III de Madrid	张博宇 王文旭	The interaction-based approach to socio-economic behavior	6 月 23 日	后主楼 1129

多彩生活

◆ 我院教工党支部组织参观孔庙和国子监博物馆

为进一步落实开展“三严三实”专题教育，2015 年 6 月 29 日上午，北京师范大学系统科学学院直属支部由狄增如院长、韩战钢副院长，以及教工支部书记樊瑛老师带队，组织教师党员一行 11 人，参观位于东城区成贤街的孔庙和国子监博物馆，亲身体验孔子儒家文化及源远流长的古代文化的博大精深。

孔庙是元、明、清三代统治者尊孔崇儒，宣扬教化，主兴文脉的圣地，也成为众多的读书人顶礼膜拜的殿堂；国子监是元、明、清三代国家管理教育的最高行政机关和国家设立的最高学府。我院教师党员先后参观了先师门、大成门、碑亭、辟雍殿等文化展示区，导游为大家讲解了砚水湖、太学府、触奸柏、进士题名碑等历史典故，帮助教师党员深入地了解了孔子的博学仁爱，以及古代圣贤的为官为民之道。随后，老师们还重点参观了《中国古代官德文化展》，展览共分为官德思想、官德制度、官德文化三方面主要内容，由“官德思想，源远流长”、“主

流意识，为政以德”、“制度实践，保障德行”、“清流物议，引领风气”、“明君明主，任贤爱民”和“良臣循吏，中流砥柱”等 6 个单元组成，从整体上展示了中国古代官德思想的起源、发展和演变，帮助大家系统的学习了古代官员的选拔、管理和监察制度，以及古代官员的各种官德事迹。

通过参观，大家了解了官德思想、士大夫品格的养成、制度实践和古代官德的人物事迹。老师们纷纷表示，借鉴我国历史上优秀廉政文化，不断提高拒腐防变和抵御风险能力，是一种很好的党员廉政教育方式，也表示在一定会坚守平凡岗位，坚持秉承先贤思想，做“有理想信念，有道德情操，有扎实学识，有仁爱之心”的“四有”好老师。