

Accepted Manuscript

Phase transition of Surprise optimization in community detection

Ju Xiang, Yan-Ni Tang, Yuan-Yuan Gao, Lang Liu, Yi Hao, Jian-Ming Li,
Yan Zhang, Shi Chen



PII: S0378-4371(17)30982-2
DOI: <https://doi.org/10.1016/j.physa.2017.09.090>
Reference: PHYSICA 18695

To appear in: *Physica A*

Received date: 6 April 2017
Revised date: 30 July 2017

Please cite this article as: J. Xiang, Y.-N. Tang, Y.-Y. Gao, L. Liu, Y. Hao, J.-M. Li, Y. Zhang, S. Chen, Phase transition of Surprise optimization in community detection, *Physica A* (2017), <https://doi.org/10.1016/j.physa.2017.09.090>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Phase transition of Surprise optimization in community detection

Ju Xiang^{1,2}, Yan-Ni Tang², Yuan-Yuan Gao², Lang Liu³, Yi Hao^{2,*}, Jian-Ming Li^{1,*}, Yan Zhang^{3,*}, Shi Chen³

¹ Neuroscience Research Center, Changsha Medical University, Changsha, 410219, Hunan, China.

² Department of Basic Medical Sciences, Changsha Medical University, Changsha 410219, Hunan, China

³ Department of Computer Science, Changsha Medical University, Changsha, 410219, Hunan, China.

* Corresponding authors.

E-mail: xiang.ju@foxmail.com or xiangju@aliyun.com (J.X.); haoyi5000@163.com (Y.H.); zhangyancsmu@foxmail.com (Y.Z); ljjm0901@sina.com (J.M.L.);

Abstract: Community detection is one of important issues in the research of complex networks. In literatures, many methods have been proposed to detect community structures in the networks, while they also have the scope of application themselves. In this paper, we investigate an important measure for community detection, Surprise [Sci. Rep., 2013, 3: 1060; Bioinformatics, 2014, 30: 1041], by focusing on the critical points in the merging and splitting of communities. We firstly analyze the critical behavior of Surprise and give the phase diagrams in community-partition transition. The results show that the critical number of communities for Surprise has a super-exponential increase with the increase of the link-density difference, while it is close to that of Modularity for small difference between inter- and intra-community link densities. By directly optimizing Surprise, we experimentally test the results on various networks, following a series of comparisons with other classical methods, and further find that the heterogeneity of networks could quicken the splitting of communities. On the whole, the results show that Surprise tends to split communities due to various reasons such as the heterogeneity in link density, degree and community size, and it thus exhibits higher resolution than other methods, e.g., Modularity, in community detection. Finally, we provide several approaches for enhancing Surprise.

PACS: 89.75.-k; 89.75.Fb; 89.75.Hc

Keywords: Complex networks; Community detection; Optimization; Surprise; Phase transition

1. Introduction

The past decades have witnessed the development of complex networks in various fields and many common topological properties in the networks were discovered and investigated extensively [1-5]. Community structures have been found to widely exist in various complex networks, including biological, technological and social networks, meaning that the networks often consist of groups of nodes with densely inner links while sparsely outer links [1, 2]. As one of important issues in network theory, community detection has attracted much attention. Because it is of help in understanding the structures and functions of complex networks, such as the analysis of the functional modules and the cycles and metabolic pathways in the biological networks [1, 2, 6], and in dealing with some related problems in complex systems, such as the identification of functional urban areas in city [7]. And it was found that community structures in complex networks can affect the dynamical processes on the networks, which may be helpful for understanding and improving the dynamical behaviors in

Download English Version:

<https://daneshyari.com/en/article/7376647>

Download Persian Version:

<https://daneshyari.com/article/7376647>

[Daneshyari.com](https://daneshyari.com)