<<复杂网络引论>>

图书基本信息

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内容概要

《复杂网络引论：模型、结构与动力学（英文版）》是为自然科学、数学和工程领域的研究生以及本科高年级学生编写的一本入门教科书，可以作为一个学期教学使用的讲义，也可以作为科研参考书或自学读物。
《复杂网络引论：模型、结构与动力学（英文版）》力求正确和准确，但并不刻意采取十分严谨的写法，以期通俗易懂，侧重于主要思想和基本方法的介绍，仅提供启发性的数学支撑，希望具有初等微积分、线性代数和常微分方程的读者能够轻松地学习书中的主要内容。
全书分成两大部分：第一部分是基础理论，包括背景材料和信息并附有适量的练习题，旨在让读者熟悉一些最基本的建模方法和分析技巧。
第二部分是应用选题，包括复杂网络在几个代表性领域中的应用研究，这些章节彼此相对独立。
最后一章是近年来比较活跃的几个前沿研究课题的简介。
各章均附有详细的关键文献，希望能够帮助有兴趣的读者很快地进入这些研究领域。

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书籍目录

章节摘录

版权页： 插图： 4.2.7 Router-Level Internet Topology A common tool to represent the router-level Internet topology by a graph is the traceroute （Unix traceroute or Windows NT tracert.exe）, or its IPv6 version, traceroute6 （35）. The traceroute uses hop-limited probe, which consists of a hop-limited IP （Internet Protocol） packet and the corresponding ICMP （Internet Control Message Protocol） response, to probe every possible IP address and record every reached router and the corresponding edges. An earlier attempt in 1995 （36） was to use traceroute to trace 5,000 hosts, selected from a network accounting database. After the 5,000 destinations were selected, 11 of them were used as the new sources of routes to trace the remaining destinations. This eventually produced a graph of 3,888 nodes and 4,857 edges, excluding those routers that could not be traced due to transient routing or other technical problems. The analytical results show that more than 70% of the nodes have degree 1 or 2, and they do not belong to the core. The major limitation of this method is that it heavily depends on the choice of the destinations, namely, it needs to choose a certain number of destinations representing a subset of the Internet structure, to obtain the routing information before probing. An intelligent heuristic technique was then introduced （37） to overcome this drawback, by using heuristic to decide whether the network includes a single node. This technique does not require an initial database of targets for exploring the network topology. Based on some careful analysis of the collected data, consisting of nearly 150,000 nodes （routers and interfaces） and almost 200,000 edges, it was found （38） that the degree distribution of nodes with degree less than 30 follows a power-law form. However, the distribution of nodes with degree larger than 30 turns out to be significantly different: it has a faster cut-off other than a power-law distribution, indicating that there may be another law governing the distribution of higher-degree nodes in the network. Moreover, it was found that the distribution of the numbers of node-pairs within a certain number of hops in the network follows neither exponential （39） nor power-law form. Some analysis on the real data collected during October and November f 1999 shows that the hierarchical characteristic basically does not exist in the router-level of the Internet topology （40）, where the node-degree distribution has a power-law behavior which however is smoothed out by a clear exponential cut-off. Therefore, the Weibull distribution, instead of the power-law distribution, can fit the collected data better, agreeing with the result reported in （38）. However, this approach could not give a complete map of the Internet topology since it fails to represent the details of the Stub subnets although it can capture the topology of the Transit portion of the Internet. It is therefore suggested that probing from a large number of sources may be able to improve the performance regarding the completeness of the traceroute-style probes （41）. Recently, Border Gateway Protocol （BGP） routing tables were examined to determine the destinations of a traceroute （42）. A directed probing technique was used to interpret BGP tables thereby identifying relevant traceroutes and pruning the remainders （42）. A path reduction technique can also be used to identify redundant traceroutes, so as to generate a router-level Internet topology. An advantage of using these two techniques is that it can significantly reduce the number of required traces without sacrificing the accuracy. Actually, compared to the brute-force all-to-all approach, this method of combining the directed probing and the path-reduction techniques can reduce the number of required traces significantly by three orders in magnitude. Some analytical results on the real data collected during December 2001 to January 2002 show that the Weibull distribution can better fit the complementary cumulative distribution function of router out-degree than the Pareto （power-law） distribution （42）. In general, however, because most Internet Service Providers regard their routerlevel topologies as confidential, and there exist some technical problems such as multiple interfaces and hence multiple IP addresses for a single router, it is still a challenging task to build a relatively complete router-level Internet topology today. 4.2.8 Geographic Layout of the Internet Due to the lack of topological information about the Internet with geographic layout of AS and routers, very little work has been done to explore the geometry of the Internet infrastructure to date. One earlier work on this issue （43） used the NetGeo tool, developed by CAIDA （44）, to identify the geographic coordinates of 228,265 routers of the Mercator map, aiming at investigating the fundamental driving forces that shape the Internet's evolution. The obtained Internet topology, embedded with geographic information of routers, allows one to analyze the physical layout of the Internet infrastructure. It is found that routers form a fractal set with fractal dimension Df = 1.5 ± 0.1, and that they strongly correlate with the population density around the world, as illustrated by Fig. 4.22, where （a ） is the router distribution density of the geographic locations of 228,265 routers of the Mercator map, and （b） is the population density distribution calculated based on the CIESIN population data （45）.

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