RANDOM GRAPHS: COMBINATORICS, COMPLEX NETWORKS AND DISORDERED SYSTEMS

3 May - 9 May 2020

ABSTRACT

Since the turn of the millennium the theory of random graphs has advanced by leaps and bounds. While in the early days random graphs were confined to the role of proof gadgets in combinatorics, today they have found very many applications, and many unexpected applications, in a remarkable variety of disciplines as well as in remarkably diverse roles within a single discipline. For instance, in computer science random graphs supply expander graphs, applied vitally in complexity theory. Additionally, viewed from a totally different angle and strongly inspired by ideas and insights from statistical physics, their use has led to celebrated tight lower bound proofs concerning the complexity of counting and sampling. A further example, perhaps the single most spectacular one, has been the recent use of random graphs in the construction of error correcting codes called 'low-density parity check' codes. These codes match the Shannon bound and admit efficient algorithms for en- and decoding, thereby providing a complete, conclusive and entirely practical solution to a fundamental problem. Moreover, today random graph models play a vital role in the context of network science, a profoundly interdisciplinary area that stretches from the social sciences to biology to engineering. For instance, models have been seized upon to analyse, simulate and cope with the spread of epidemics, both natural and digital. Furthermore, models of complex networks do not only provide benchmarks for the development of novel powerful algorithms that exploit the characteristic features of real networks, but they also support in explaining the processes that bring these same features about.

As the study of random graphs expanded from a confined precinct of combinatorics to a cross-section discipline, the community also grew more diverse. To name just the most prominent representatives, today random graphs are studied by mathematicians, computer scientists, statisticians and physicists. While this growing diversity led to a great proliferation of new models, questions and results, the community also shattered, and by now different methods, terminologies and research programmes coexist without much interaction. The aim of the workshop is to bring together the principal communities that have been contributing to the recent advance of random graph theory yet do not normally cross paths at their intra-community venues.

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