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On the Design of Methods to Estimate Network Characteristics

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Abstract
Social and computer networks permeate our lives. Large networks, such as the Internet, the World Wide Web (WWW), AND wireless smartphones, have indisputable economic and social importance. These networks have non-trivial topological features, i.e., features that do not occur in simple networks such as lattices or random networks. Estimating characteristics of these networks from incomplete (sampled) data is a challenging task. This thesis provides two frameworks within which common measurement tasks are analyzed and new, principled, measurement methods are designed. The first framework focuses on sampling directly observable network characteristics. This framework is applied to design a novel multidimensional random walk to efficiently sample loosely connected networks. The second framework focuses on the design of measurement methods to estimate indirectly observable network characteristics. This framework is applied to design two new, principled, estimators of flow size distributions over Internet routers using (1) randomly sampled IP packets and (2) a data stream algorithm.

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