

STATISTICAL LEARNING IN NETWORKING

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The area of statistical learning [1, 2] has received much interest in the last decade, which is due both to its success in solving practical problems and its theoretical foundations. These have roots in optimization, statistics, geometry, linear algebra and analysis. Learning techniques have been developed in various areas of networking, such as adaptive routing, cognitive Medium Access Control and power management of wireless devices, which are of vital importance in large mobile, distributed and ad hoc networks. As an example, in [3], we have applied kernel learning to handover management in heterogeneous radio networks. Kernel regression is applied to dynamically learn the utility of each network in terms of cost and quality of service (e.g. low transport delay). Since kernel methods can be computationally intensive, we are also interested in investigating methods that allow fast, approximate computations, e.g. based on dimension reduction via random projections. Utility optimization in networks is a very active area of engineering research. Interest has grown tremendously since it was shown that data transport control protocols in communications networks such as the Internet can be modeled as distributed solutions to global mathematical optimization problems [4]. An excellent survey of the state of the art is [5] (see also [6] and references). Originally, the tools used were duality theory of convex optimization, and non-cooperative game theory. In recent years, focus has expanded to include modeling of stochastic effects and non-convex optimization problems, using techniques from e.g. geometry and geometric programming. The variety and sophistication of the techniques is increasing with the complexity of the networks and protocol interactions modeled. Having mathematical models of protocols, their goals and interactions leads to better understanding of the behavior of current network protocols, and allows principled design of new ones. In this project, we will explore problems in (cognitive) network management of mobile distributed ad hoc networks using techniques from both optimization and statistical learning.

References

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