Optimizing under explorable uncertainty

Uncertainty in the input data can be addressed using many different approaches, such as robust optimization or stochastic optimization, for example. These approaches have the common assumption that the uncertain information --- some parameters of the problem instance --- cannot be explored before making decisions, i.e., computing a solution. However, in many applications there is the opportunity to gain exact or more precise information at a certain additional cost, e.g., by investing time, money, or bandwidth. For instance, in computational geometry, the coordinates of some points may be the result of a heavy computation which can be run longer in order to obtain more precision. Another real life example is a company which is planning to bring a product on the market, and needs to invest prior into costly market studies in order to understand what features of the product will lead to higher sales rates.

Hence we are interested in this relatively new setting, in which the algorithm has the power to query some input parameters in order to gain precision. Formally the input parameters are given in a form of an uncertain interval, and the algorithm only knows that the values belong to this interval. It can then make a query which reveals the precise value. The quality of a solution is subject to the uncertainty of the un-queried input parameters. Usually we focus on the worst case objective value of the solution over all possible input parameters within the given intervals.

This means there is clearly a trade-off between the number of queries made by the algorithm and the quality of the produced solution.

The goal is to study classic combinatorial optimization problems in this framework.