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MADALGO seminar by Peyman Afshani, Aarhus University

Instance-Optimal Geometric Algorithms

Abstract:

Standard worst-case analysis of algorithms has often been criticized as overly pessimistic. As a remedy, some researchers have turned towards *adaptive* analysis where the cost of algorithms is measured as a function of not just the input size but other parameters, such as the output size. The ultimate in adaptive algorithms is an *instance-optimal* algorithm, i.e., an algorithm whose cost is at most a constant factor from the cost of any other algorithm running on the same input, for *every* input instance. In other words, an instance-optimal algorithm cannot be beaten by any other algorithm on any input.

For many problems, this requirement is too stringent but we show that if we ignore the order of the input elements (i.e., we assume the input is given in the worst case order), then adaptive algorithms exist for many fundamental geometric problems such as convex hull. Thus, these convex hull algorithms are optimal with respect to *all* the measures of difficulty that are independent of the order, such as output-size, spread of the input point set or more complicated quantities like the expected size of the convex hull of a random sample.

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