



## Computer and Information Sciences DISTINGUISHED LECTURE

**Richard M. Karp**

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### *Heuristic Algorithms in Computational Molecular Biology and Genetics*

**Wednesday, 9/28, 11am, Walk Auditorium, Ritter Hall**

**Abstract:** In many practical situations heuristic algorithms reliably give satisfactory solutions to real-life instances of optimization problems, despite evidence from computational complexity theory that the problems are intractable in general. Our long-term goal is to contribute to an understanding of this seeming contradiction, and to put the construction of heuristic algorithms on a firmer footing. In particular, we are interested in methods for tuning and validating heuristic algorithms by testing them on a training set of "typical" instances. As a step in this direction we describe the evolution and validation of three heuristic algorithms motivated by problems in computational molecular biology and genetics:

- (1) A generic algorithm for the class of implicit hitting set problems, which includes feedback vertex set and feedback edge set problems, the max-cut problem, the Steiner tree problem, the problem of finding a maximum feasible subset of a set of linear inequalities, matroid intersection problems and a problem of global genome alignment (joint work with Erick Moreno Centeno).
  - (2) The Colorful Subgraph Problem: given a graph in which each vertex is assigned a color from a set  $S$ , find the smallest connected subgraph containing at least one vertex of each color in  $S$ . (joint work with Shuai Li)
  - (3) The problem of clustering the vertices of a graph into small near-cliques. (joint work with Shuai Li).
- The speaker will briefly explain the biological motivation for each problem.

**Bio:** Richard M. Karp was born in Boston, Massachusetts on January 3, 1935. He attended Boston Latin School and Harvard University, receiving the Ph.D. in 1959. From 1959 to 1968 he was a member of the Mathematical Sciences Department at IBM Research. From 1968 to 1994 and from 1999 to the present he has been a Professor at the University of California, Berkeley, where he held the Class of 1939 Chair and is currently a University Professor. From 1988 to 1995 and 1999 to the present he has been a Research Scientist at the International Computer Science Institute in Berkeley. From 1995 to 1999 he was a Professor at the University of Washington. During the 1985-86 academic year he was the co-organizer of a Computational Complexity Year at the Mathematical Sciences Research Institute in Berkeley. During the 1999-2000 academic year he was the Hewlett-Packard Visiting Professor at the Mathematical Sciences Research Institute.

The unifying theme in Karp's work has been the study of combinatorial algorithms. His 1972 paper "Reducibility Among Combinatorial Problems" showed that many of the most commonly studied combinatorial problems are NP-complete, and hence likely to be intractable. Much of his work has concerned parallel algorithms, the probabilistic analysis of combinatorial optimization algorithms and the construction of randomized algorithms for combinatorial problems. His current activities center around algorithmic methods in genomics and computer networking. He has supervised thirty-nine Ph.D. dissertations.

His honors and awards include: U.S. National Medal of Science, Turing Award, Kyoto Prize, Fulkerson Prize, Harvey Prize (Technion), Centennial Medal (Harvard), Dickson Prize (Carnegie Mellon), Lanchester Prize, Von Neumann Theory Prize, Von Neumann Lectureship, Distinguished Teaching Award (Berkeley), Faculty Research Lecturer (Berkeley), Miller Research Professor (Berkeley), Babbage Prize and ten honorary degrees. He is a member of the U.S. National Academies of Sciences and Engineering, the American Philosophical Society and the French Academy of Sciences, and a Fellow of the American Academy of Arts and Sciences, the American Association for the Advancement of Science, the Association for Computing Machinery and the Institute for Operations Research and Management Science.