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Seminar ELE 518-Spring 2008

Speaker: Wojciech Szpankowski, Professor, Purdue University
Date: Tuesday, March 11th
Time: 4:30pm
Room: B205 ~ Equad

Title: ALGORITHMS, COMBINATORICS, AND INFORMATION

Abstract: Algorithms are at the heart of virtually all computing technologies; combinatorics provides indispensable tools for finding patterns and structures arising in various problems of science and engineering; information permeates every facet of our life and is the distinguishing mark of our era. We discuss a handful of technical results of source coding to illustrate the interplay between algorithms, combinatorics, and information. We first present an algorithm that solves a long-standing problem of eliminating the devastating effect of a limited number of errors in the popular Lempel-Ziv'77 scheme. We achieve this goal by recovering multiple matches in LZ'77 and using them for error correction. An array of analytic and combinatorial techniques that belong to analytic information theory are applied to show that the number of redundant bits is well concentrated around the mean, a highly desirable property. Then, we deal with the method of types, a powerful technique in information theory and analysis of algorithms. We shall argue that counting types can be accomplished efficiently by enumerating Eulerian paths (Markov types) or binary trees with a given path length (universal types). Finally, we discuss one-to-one codes whose average length is smaller than the source entropy in defiance of the lower bound of Shannon. In the last part of this talk we briefly reflect on information in its generality, and muse on some problems in the interface of computer science and information theory. In conclusion, we describe a few pertinent challenges that bridge Shannon information with Boltzmann's entropy, Maxwell's demon, Landauer's principle, Bennett's irreversible computations, and also timeliness and value of information.

Bio: Wojciech Szpankowski is Professor of Computer Science and Electrical and Computer Engineering at Purdue University. In 1992 he was Professeur Invite at INRIA-Rocquencourt, France, in 1999 he was Visiting Professor at Stanford University, and in 2006 the Erskine Fellow at University of Canterbury, Christchurch, New Zealand. His research interests cover analysis of algorithms, information theory, bioinformatics, and also analytic combinatorics, and stability problems of distributed systems. He published the book "Average Case Analysis of Algorithms on Sequences", John Wiley & Sons, 2001. Szpankowski has been a guest editor and an editor of technical journals, including Theoretical Computer Science, ACM Transaction on Algorithms, IEEE Transactions on Information Theory, Foundation and Trends in Communications and Information Theory, and Combinatorics, Probability, and Computing (CPC). In June 2004 he directed the MSRI Graduate Program on the "Analysis of Algorithms and Information Theory". He is a Fellow of the IEEE.