PREFACE

This special issue is devoted to the *Average-Case Analysis of Algorithms.* Analysis of algorithms aims at a precise prediction of the expected performances of algorithms and data structures of general use in computer science. Quantification of performance goes from mean value estimates of costs to analysis of the probability distributions involved, under natural randomness models of the data.

The area of analysis of algorithms was born on July 27, 1963 when D. E. Knuth analyzed in his "Notes on Open Addressing" hashing tables with linear probing.

Since 1963 the field has undergone tangible changes. We see now the emergence of combinatorial and asymptotic methods that permit us to classify data structures into broad categories that are susceptible to a unified treatment. Probabilistic methods that have been so successful in the study of random graphs and hard combinatorial optimization problems also play an important rôle in the field. These developments have two important consequences for the analysis of algorithms: it becomes possible to predict average-case behaviour under more *general* probabilistic models; at the same time it becomes possible to analyze much more structurally *complex* algorithms.

In July 1993, the first seminar entirely devoted to analysis of algorithms took place in Dagstuhl, Germany. On that occasion a special issue of *Theoretical Computer Science* (vol. 144, No. 1–2, 1995) was prepared. In 1995 a second seminar on *Average-Case Analysis of Algorithms* was held again in Dagstuhl and a special issue of *Random Structures & Algorithms* (vol. 10, No. 1–3, 1997) was edited by P. Flajolet and W. Szpankowski. The 1997 seminar (again in Dagstuhl) was followed by a special issue in *Algorithmica* (vol. 22 (1998), 363-690). In 1998, the seminar moved to Princeton, and the present special issue is based on it.

Since 1997, the Analysis of Algorithms community has had a homepage (`http://www-rocq.inria.fr/algo/AofA/index.html`).

Contributions

Analysis of algorithms typically deals with permutations, words, trees, strings, numbers and graphs, under various probabilistic models.

Rösler was able to prove the existence of a limiting distribution for Quicksort several years ago by a contraction method that he proposed. Around the same time (but published somehow later) Rüschendorf came up with a similar machinery. Subsequently, both schools used the methods for a variety of problems. We asked them to combine their efforts and write a tutorial. This is the invited paper of this issue. Rösler contributes a second paper about divide and conquer algorithms.

Andrews and Knopfmacher use generalized Engel expansions for power series to prove identities of the Rogers–Ramanujan type, using polynomials of Schur.

Hwang and Chern consider the phase transition for Quicksort with some preprocessing (improved Quicksort).

Vallée is developing a novel approach towards information theory, using ideas from functional analysis. In a further contribution, together with Clement and Flajolet, this approach is extended to a full analysis of hybrid trie structures (array–trie, list–trie, and binary–search–trie), under the Poisson and Bernoulli model.

Drmota uses purely analytic techniques to attack the average height of binary search trees — something that people have wanted to see for decades. Drmota, Gardy and Gittenberger analyze urn models that are of relevance in the analysis of algorithms.

Hansen and Schmutz consider a minimization problem on random graphs.

The paper of Martinez, Panholzer and Prodinger deals with partial match queries. A randomized approach makes the analysis easier, but the performance is almost as good as the original more sophisticated version.

The contribution of Panario and Richmond is based on the general situation of smallest substructures. As with its more prominent counterpart of largest substructures, this parameter is of general interest. The challenging analysis involved functions otherwise known in analytic number theory (Buchstab's and Dickman's function).

Poblete deals with a problem on order statistics that leads to interesting recursions. They resemble the Quicksort recursions and lead to a certain transition diagram (finite automaton).

In terms of methodology, this issue illustrates the two major paradigms of analysis of algorithms. Objects of low structural complexity (for instance, strings, trees, permutations) can often be described exactly by analytic models, where generating functions, integral transforms, and complex asymptotics are central tools. Objects of higher structural complexity (e.g., graphs) are best approached by probabilistic inequalities, since an analytic model is often out of reach. There is however no firm dividing line, as exemplified by many papers in this volume: on the one hand, the analytic method is often capable of providing information on probability distributions of interest; on the other hand, the probabilistic method is often applicable to problems of low computational complexity.

We are very grateful to C. K. Wong, the Editor–in–Chief of *Algorithmica* for having provided the opportunity to prepare this special issue. We hope that the readers will find this volume interesting as well as useful in their scientific endeavours.

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Guest Editors