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1 Overview

This pair of volumes is an extensive compendium of survey articles on issues of current importance in theoretical CS research. Without a shadow of a doubt it is a much needed resource for any theory researcher, as well as serving as a detailed introduction to the field for non-specialists. The first volume covers algorithms and algorithmic techniques, aspects of data structures, complexity theory, formal languages and computability, in addition to having a handful of chapters on related but more specialised topics, such as learning theory, coding theory, parallel and distributed computing. This volume in itself is a treasure of material in core computer science and can serve as a replacement for more specialised texts when only a good foundation is required. The articles are written by experts in the field and are eminently readable.

There is a couple of very useful chapters on searching and sorting algorithms, which can be used as a complement and gentle introduction to Knuth's seminal tome [1] on the subject. But to have, in the very same volume, an equally accessible introduction to convex optimization, and another on simulated annealing, makes for a rich and enjoyable afternoon read. In fact, you may find yourself wondering many times whether you could change research topic or theme, as this volume is rather inspiring!

While there is still emphasis on algorithms and algorithmic approaches, Volume II has a broader remit and introduces several application areas, including AI and robotics, cryptography, voting and auction schemes, privacy and databases, computational biology, grid and DNA computing. What a feast! The coverage of cryptography, cryptanalysis and security protocols is particularly extensive, which makes this a useful reference for security research. The chapter on privacy and anonymity is particularly relevant and a very timely review of k-anonymity techniques. In the wake of Narayanan and Shmatikov's recent award-winning results on the de-anonymisation of the Netflix prize database [2], this material is particularly interesting and should serve as a foundation for further research on anonymity and anonymisation methods.

It is not possible to review this pair of volumes in the usual manner, due to their length and the sheer breadth of material. I will provide the table of contents for both volumes in Section 2, however, for readers of this review to get an inkling of the variety therein. Then I will give and justify my opinion of this text, concluding with references.

Comparison with *Handbook of Theoretical Computer Science*

It is interesting to make a comparison with the already established *Handbook of Theoretical Computer Science* [3, 4], edited by Leeuwen. Leeuwen's book is also extensive, and is similarly divided into one volume on Algorithms and Complexity [3] and another on Formal Models and Semantics [4].

First one should point out that Leeuwen's book is older, and is not designed to be as broad an introduction as this one is. So the contributions in the former tend to be not just survey articles, but often also focused research articles which also give general background on the topics of interest. There is some degree of overlap, especially with regard to complexity theory, but Leeuwen's volumes do not introduce algorithmics in a textbook manner. Some of the chapters have very similar coverage to those in this handbook (under review), although this handbook is more up-to-date. VLSI theory is covered in both, data structures, cryptography and graph algorithms also.

The fundamental difference between the *Handbook of Theoretical Computer Science* by Leeuwen and the handbook under review is one of style. While the former has detailed chapters on a selection of topics, the latter has more extensive and systematic coverage of algorithms arising across the spectrum of computer science research.

The next section shows the contents of the two volumes. In Section 3 I round off this review with a personal view.

2   Tables of Contents

2.1   Volume I: General Concepts and Techniques

2.2 Volume II: Special Topics and Techniques

3 Opinion

I think this handbook is an essential resource for any computer science researcher, whether theorist or practitioner. It comes at a price, but the introductory coverage of such a wide range of topics is likely to be useful throughout one's career in computer science. For the moment, it is also a practical way of getting into some of the "hot" areas of the field, and I found the chapters on DNA computing and computational systems biology very welcoming.

One omission from this handbook which I believe could be addressed in a future edition would be a chapter on quantum algorithms. The rapid growth of this field cannot be ignored, and its impact on computing cannot be underestimated as we get closer and closer to transcribing bits on the atomic scale. The efficiency of quantum algorithms, namely the massive parallelism which is... unparalleled by their classical counterparts, makes for an exciting and attractive research proposition. Inclusion of a chapter on this material in a handbook such as this one would make the field more accessible to a wider audience.

All in all, I highly recommend this pair of volumes for inclusion in your bookshelf.

References

[1] Donald E. Knuth. *The Art of Computer Programming*, volume 3: Sorting and Searching. Addison-Wesley Professional, 2nd edition, 1998.

[2] Arvind Narayanan and Vitaly Shmatikov. Robust de-anonymization of large sparse datasets. In *Proceedings of 29th IEEE Symposium on Security and Privacy, Oakland, CA*, pages 111—125, May 2008.

[3] Jan van Leeuwen, editor. *Handbook of Theoretical Computer Science*, volume A: Algorithms and Complexity. MIT Press, 1994.

[4] Jan van Leeuwen, editor. *Handbook of Theoretical Computer Science*, volume B: Formal Models and Semantics. MIT Press, 1994.