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13th Conference
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PREFACE

For more than a decade, Foundations of Software Technology and Theoretical Computer Science Conferences have been providing an annual academic computer science forum for the presentation of new results in the topics of current research in India and abroad. This year, there was a total of 119 papers from 20 countries. Each paper was reviewed by at least three reviewers in that particular area. Based on these reviews, the Programme Committee selected 33 papers at the Programme Committee Meeting held on 30-31 July 1993 at the Tata Institute of Fundamental Research, Bombay. This is the highest number of papers selected for presentation in a FST&TCS Conference so far. In spite of this, we had to omit many other good papers. Apart from the attractive conference programme containing five invited papers, the program includes a panel on Software Technology (moderated by R. Narasimhan) and demonstration of systems relevant to some of the papers presented. The conference will be preceded by a workshop for graduate students doing their doctoral dissertation in Computer Science. This workshop (coordinated by S. Ramesh, IIT, Bombay) will provide a technical forum for Ph.D. students to present their current work, and a forum to discuss Computer Science prospects and future in Indian Universities and Industry.

It is a pleasure to thank the invited speakers, Henk Barendregt, Gérard Berry, Joseph Y. Halpern, Juris Hartmanis and Ketan Mulmuley for accepting our invitation to give talks and contribute papers to the proceedings. The referees deserve a great deal of gratitude for their careful attention and response often at very short notice.

In spite of the economic crunch facing the country, Tata Institute of Fundamental Research (TIFR) has been generous in providing a strong support for organizing the conference. I thank TIFR for the financial and infrastructural support they have been providing over the years for this conference series. I also thank IISc (Bangalore) for providing partial financial support for the conference.

John Barretto assisted by J.L. Britto, both from TIFR, provided all the secretarial help. They did a tremendous job and special thanks go to them. I thank the editorial staff of Springer-Verlag, in particular Alfred Hofmann, for all the help and understanding in bringing out the proceedings in time for the conference.

October 1993

R.K. Shyamasundar

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Some Observations About the Nature of Computer Science

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Abstract. This paper discusses the nature of computer science as a science by analyzing computer science and comparing or contrasting it with other sciences. In particular, we compare and contrast various aspects of computer science with physics, astronomy, and mathematics.

Our analysis of computer science and comparison with other sciences is primarily in terms of:

- (a) the roles played by experiments and theory,
- (b) how research paradigms and problem areas are determined and change,
- (c) the relation and interaction of the science and engineering aspects,
- (d) comparing historical developments.

From this study and comparisons we conclude that computer science differs from the known sciences so deeply that it has to be viewed as a new species among the sciences. This view is justified by observing that theory and experiments in computer science play a different role and do not follow the classic pattern in physical sciences. The change of research paradigms in computer science is often technology driven and demos can play the role of experiments. Furthermore, the science and engineering aspects are deeply interwoven in computer science, where the distance from concepts to practical implementations is far shorter than in other disciplines.

Introduction

We all are witnessing an information revolution which is profoundly changing all aspects of our societies. This revolution is driven by unprecedented advances in computing power and communications capacity, and it is guided by computer science and engineering. It is quite likely that the changes caused by this revolution will rival those of the industrial revolution. Computing is already embedded in the fabric of our societies, but this is just the beginning of a complete penetration of all our activities as all information is digitalized and computing becomes ubiquitous in our physical and intellectual environment.

Personally, I am deeply convinced that computer science is a very important new science and that it is important that its nature as a science is understood better not only by the practitioners, but also by other scientists and the people who make decisions about science policy and support. It is important to understand where computer science fits in the constellation of sciences, how it relates, compares and differs from other sciences. It is particularly important to understand its research paradigms and methodology. One can cite many instances where lack of understanding of the nature of computer science has led to wrong expectations, to lack of appreciation of the achievements (since it does not behave like some other science) and incorrect policy decisions.

There is no doubt that computer science and engineering has played a very important role in guiding and facilitating the information revolution. At the same time, computer science is not very well understood as a science by other scientists and even by people close to computer science themselves.

This short paper will give only a few partial answers to the questions about the nature of computer science. A much more extensive comparison with paradigms, methodology and historical development of other sciences has to be made, and a much richer set of examples and case studies is needed for a proper understanding. At the same time, it is hoped that this paper will add to the insights about the nature of computer science and stimulate discussion and interest in further analysis. Particularly important is to collect more illustrations and case studies from various parts and periods of computer science.

In general, I believe that the historical development and the epistemological nature of computer science should be of considerable interest to historians and students of the philosophy of science. So far, there have been very few serious studies along these lines. I hope that will change soon, since this is indeed a rich new area of investigation of a very rapidly developing new species among the sciences.

The Other Sciences

To see the uniqueness of computer science and to justify our claim that it has to be viewed as a new species among the sciences, we discuss shortly the classic