

Second International Computer Programming Education Conference

ICPEC 2021, May 27–28, 2021,
University of Minho, Braga, Portugal

Edited by

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Alfred Aho and Jeffrey Ullman
Turing Award Winners for 2021

for their work on the theory of compilers,
allowing us to use programming languages.

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■ Preface

The success of the 2020 edition of the 'International Computer Programming Education Conference (ICPEC)' impelled us to organize a new edition under the general topic of Computing at School. We actually believe that children shall be introduced to the computing world at primary school, and even younger people shall start earlier to train their skills to solve problems acquiring what is nowadays called *Computational Thinking*.

Four speakers from UK, Brasil, and Portugal were invited to talk about their motivations and experiences leading in their countries the referred international movement Computing at School.

Following the first edition of ICPEC, the second edition was once again online. We all know that a remote conference is always restrictive in terms of networking that is usually built at events of this kind. However, the typology of the event did not limit the participation among researchers and teachers on the main topic of the ICEPC, which is, the discussion on methodologies, trends and tools to improve the teaching-learning process of computer programming.

Inevitably, the papers in this second edition cover different approaches to overcome not only the complexity inherent to the field of computer programming, but also to mitigate the disadvantages of this new teaching paradigm caused by the pandemic. Many approaches are discussed in this conference, ranging from psychological studies to computer-mediated teaching tools including resources to aid children with special needs.

This book compiles 18 papers, accepted and revised for the 2.nd edition of ICPEC'2021, held virtually at Minho University, Braga, Portugal, from 27th to 28th of May.

The introduction of specialized services to automate tasks traditionally done manually by teachers or the inclusion of visualization mechanisms, playful design and gamification to involve students are the most discussed topics.

In the first case, the tendency is to integrate digital assistants or services in order to alleviate all (or part) of the manual phases of the teaching-learning process of computer programming. In this context, works related to tasks that typically are naturally time-consuming and error-prone are presented, such as the creation of programming exercises, program evaluation and feedback generation. It should be noted that in these topics there is a common point that concerns researchers and that relates to interoperability, not only in terms of data representation but also in the way the data is communicated between systems.

In the second case, several works related to game-based solutions are presented. To involve and motivate students in the computer programming domain, there are papers describing the use of visual feedback during the execution of programs, or the injection of gamification elements such as the use of leaderboards, achievements, badges and levels. To foster immersion, some authors propose the inclusion of virtual reality or the resort to serious games. Researchers consider that the use of approaches that inherit many concepts from games, should be applied sparingly so systems that use them do not transform into environments that are demotivating, unfair or that foster too many competitive facets which will hinder healthy and cooperative learning process.

Regardless of the approach proposed, the main objective of all these works is similar: *to motivate students to learn programming by promoting the practice supported by rich and immediate feedback.*

As ICPEC'2021 Chairs, we want to thank the many people without whom this event would never have been possible.



The invited Speakers (Simon Peyton-Jones, Sue Sentance, Christian Puhmann Brackmann, and Anabela Jesus Gomes) that let us learn with their researches and experiences; all the Members of the Scientific Committee for their valuable effort reviewing the submissions to support us in deciding the final list of accepted papers; all the Members of the Organizing Committee for looking carefully after all the details concerned with the logistics necessary to put up the event. Last but not the least, we express our acknowledgments to: the Authors that communicate their fully implemented ideas or projects, or their fresh proposals that are intended to be realized in the near future; and the Participants that actually made the conference happen and be a fruitful forum for the exchange of experiences and know-how.

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