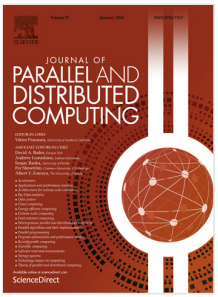
# Accepted Manuscript




Keeping up with technology: Teaching parallel, Distributed and High-Performance Computing

Sushil K. Prasad, Ioana Banicescu, Martina Barnas, Domingo Giménez, Andrew Lumsdaine

PII: S0743-7315(17)30081-3
DOI: http://dx.doi.org/10.1016/j.jpdc.2017.03.001
Reference: YJPDC 3643

To appear in: *J. Parallel Distrib. Comput.*

Please cite this article as: S.K. Prasad, I. Banicescu, M. Barnas, D. Giménez, A. Lumsdaine, Keeping up with technology: Teaching parallel, Distributed and High-Performance Computing, *J. Parallel Distrib. Comput.* (2017), http://dx.doi.org/10.1016/j.jpdc.2017.03.001

This special issue is devoted to progress in addressing one of the most important challenges facing education pertinent to computing technologies. The work published here is of relevance to those who teach computing technology at all levels, with greatest implications for undergraduate education. Parallel and Distributed Computing (PDC) along with High Performance Computing (HPC) has become pervasive. Common users now depend on parallel processing technology, as it is integral to the digital ecosystem comprising infrastructures ranging from clouds, data centers and supercomputers to personal computers, laptops, and mobile devices, with even smart phones containing multicore Central Processing Units and manycore Graphics Processing Units. This necessitates that every programmer understands how parallel processing affects problem solving. Thus, teaching only traditional, sequential programming is no longer adequate. For this reason, it is essential to impart a range of PDC and HPC knowledge and skills at various levels within the educational fabric woven by Computer Science, Computer Engineering, and related computational science and engineering curricula. However, rapid changes in hardware platforms, languages, programming environments, tools and advances in research increasingly challenge educators to decide what and how to teach in order to prepare students for their careers in technology.

In recognition of the importance of these issues and the underlying challenges, a curriculum working group from the IEEE Technical Committee on Parallel Processing (TCPP), the National Science Foundation (NSF), and sister communities such as the ACM, has taken up proposing and refining a curriculum for computer science (CS) and computer engineering (CE) undergraduates on PDC. The goal of this working group has been to propose a core curriculum for CS/CE undergraduates, with the premise that every such undergraduate should achieve a specified skill level regarding PDC-related topics as a result of their required coursework. This effort has resulted in a preliminary curriculum in 2010 and its formal version in 2012. Since 2011, this curriculum initiative has been coordinated by the NSF-supported Center for Parallel and Distributed Computing Curriculum Development and Educational Resources (CDER), with both the initiative and the center receiving additional support from Intel, nVIDIA, and IBM. The NSF/TCPP curriculum has over 100 early adopter institutions worldwide and the ACM/IEEE CS2013 Computer Science Curricula explicitly refers to this for comprehensive coverage of parallelism (and provides a direct hyperlink). To facilitate sharing of findings and experiences of the early adopters and for fostering the community, the EduPar workshop series was established at the TCPP's flagship IPDPS conference in 2011. Following the success of EduPar, the EduHPC workshop series was inaugurated at the Supercomputing conference (SC) in 2013 with greater emphasis on HPC. Both EduPar and EduHPC have the distinction of being the first workshops on PDC/HPC education at their respective premier research conferences. In 2015, reflecting the truly global nature of the community, the workshops were expanded with the first Euro-EduPar workshop at the EuroPar conference with an European orientation. In summary, there are now three workshops per year devoted to PDC and HPC education. Over the years, the workshop topics have expanded to include a range of topics pertinent to PDC and HPC education, such as outreach and informal learning environments. This constitutes an acknowledgement that PDC and HPC education is not immune to the challenges plaguing most of the STEM field education. The workshops are very successful, which indicates community's interest in Parallel, Distributed and High Performance Computing, in accordance with the necessity of initiating today's students to a technology they will work with in their professional life.

This special issue invited high-quality contributions in the fields of PDC and HPC education. While the submissions were on the topics of EduPar 2015, Euro-EduPar 2015 and EduHPC 2015 workshops, the call was open to all contributors. We received 42 submissions from all over the world, a surprisingly large number underscoring the importance of the topics. The submissions were rigorously reviewed by at least three expert external reviewers, and further evaluated by the