Introducing Beginners to Distributed Computing using Raspberry Pi Clusters

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The 2019 ABET computer science criteria requires that all computing students learn parallel and distributed computing (PDC) as undergraduates, and CS2013 recommends at least fifteen hours of PDC in the undergraduate curriculum. Consequently, many educators look for easy ways to integrate PDC into courses at their institutions. This hands-on workshop introduces Message Passing Interface (MPI) basics in C/C++ and Python using clusters of Raspberry Pis. The Message Passing Interface (MPI) is a multi-language, platform independent, industry-standard library for parallel and distributed computing. Raspberry Pis are an inexpensive and engaging hardware platform for studying PDC as early as the first course. Participants will experience how to teach distributed computing essentials with MPI by means of reusable, effective "parallel patterns", including *single program multiple data* (SPMD) execution, *send-receive* message passing, the *master-worker* pattern, *parallel loop* patterns, and other common patterns, plus longer "exemplar" programs that use MPI to solve significant applied problems. The workshop includes: (i) personal experience with the Raspberry Pi (clusters provided for workshop use); (ii) assembly of Beowulf clusters of Raspberry Pis quickly in the classroom; (iii) self-paced hands-on experimentation with the working MPI programs; and (iv) a discussion of how these may be used to achieve the goals of CS2013 and ABET. No prior experience with MPI, PDC, or the Raspberry Pi is expected. All materials from this workshop will be freely available from *CSinParallel.org*; participants should bring a laptop to access these materials.

Keywords: Raspberry Pi; MPI; Computer Science education; parallel computing; distributed computing; cluster

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