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## Verifiable application-level checkpoint and restart framework for parallel computing

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Fault tolerance of parallel and distributed applications is one of the concerns that becomes topical for large computer clusters and large distributed systems. For a long time the common solution to this problem was checkpoint and restart mechanisms implemented on operating system level, however, they are inefficient for large systems and now application-level checkpoint and restart is considered as a more efficient alternative. In this paper we implement application-level checkpoint and restart manually for the well-known parallel computing benchmarks to evaluate this alternative approach. We measure the overheads introduced by creating and restarting from a checkpoint, and the amount of effort that is needed to implement and verify the correctness of the resulting programme. Based on the results we propose generic framework for application-level checkpointing that simplifies the process and allows to verify that the application gives correct output when restarted from any checkpoint.

### Summary

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