Managing Data-Intensive Applications in the Cloud

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This installment of Computer’s series highlighting the work published in IEEE Computer Society journals comes from IEEE Transactions on Knowledge and Data Engineering.

As part of a recent initiative for IEEE Transactions on Knowledge and Data Engineering, we’re inviting contributions from leaders in related areas about strategic research and development directions and opportunities. A forthcoming article by Gang Chen, H.V. Jagadish, Dawei Jiang, David Maier, Beng Chin Ooi, Kian-Lee Tan, and Wang-Chiew Tan, entitled “Federation in Cloud Data Management: Challenges and Opportunities,” (vol. 26, no. 7, 2014) is the first installment of this series.

Recent trends show that more and more data-intensive applications are migrating to the cloud. The cloud itself will soon become highly heterogeneous in terms of data storage patterns, data types, and programming interfaces, so designing and implementing cloud data management systems accommodating this heterogeneity becomes critical.

The authors first reexamine the “shared nothing” architecture, which is popular in today’s cloud data management systems. In this architecture, the computers in the cloud don’t share any main memory or hard disk resources. Then, the authors discuss the challenges of accommodating multiple data management systems in the cloud that have similar architectures, offering their vision of technical directions for feasible solutions. As a specific example, they describe epIC, a system that some of the coauthors built to support transparent resource management and heterogeneous data processing in the cloud.

The article acknowledges asymmetric hardware capability, which is ubiquitous in practical cloud systems and contributes to the challenges in dynamic resource sharing. The well-known conflicts between two types of data-processing systems, namely, transactional processing systems and analytical systems, extend to the cloud. In contrast to existing solutions, which focus on scaling up—using more computational resources—the cloud needs solutions that can be scaled out—using more computers in a shared-nothing architecture. The authors advocate for memory locality and discuss the challenges caused by diversity in node query interfaces as well as in the system-level query interface. They specifically focus on two issues—the synchronization model and consistency in data replication—and deliberate those issues via the epIC system.

This article is timely because it addresses the current research agenda emergent in data management in the cloud. It provides insights into research leaders’ vision and critical thinking about future challenges and opportunities while also using concrete examples to demonstrate technical viewpoints.

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