

Contents

| | | |
|--|---|----|
| 1 | Introduction | 1 |
| 1.1 | Problem Statement | 6 |
| 1.2 | Contribution and Scope | 8 |
| 1.3 | Thesis Organization | 11 |
| Part I Background of Transactional and Analytical Systems in Logical Database Design and Benchmarking | | |
| 2 | Enterprise Data Management for Transaction and Analytical Processing | 15 |
| 2.1 | Data Models for Transaction and Analytical Processing | 17 |
| 2.1.1 | Transaction Processing Systems | 18 |
| 2.1.2 | Analytical Processing Systems | 28 |
| 2.2 | Relational Database Design | 35 |
| 2.2.1 | Relational Database Schemas in Transaction and Analytical Processing | 36 |
| 2.2.2 | Normalization | 38 |
| 2.2.3 | Physical Database Design | 39 |
| 2.2.4 | Database Storage | 41 |
| 2.3 | Summary | 43 |
| 3 | Benchmarks for Transaction and Analytical Processing Systems | 45 |
| 3.1 | Transaction Processing Versus Analytical Processing | 46 |
| 3.1.1 | OLTP and OLAP Workload Characteristics | 46 |
| 3.1.2 | Blurring the Border Between OLTP and OLAP | 47 |
| 3.2 | Benchmark Classification | 49 |
| 3.2.1 | Transaction Processing System Benchmarks | 50 |
| 3.2.2 | Analytical Processing System Benchmarks | 52 |
| 3.2.3 | Mixed Workload Benchmarking | 54 |
| 3.2.4 | Other Database Benchmarks | 56 |

| | | |
|---|---|------------|
| 3.3 | Key Criteria for the Value of Benchmarks | 58 |
| 3.3.1 | Established Benchmarks and the Benchmark Properties | 59 |
| 3.3.2 | Benchmark Measures | 60 |
| 3.4 | Summary | 61 |
| | | |
| Part II Towards a Benchmark for Mixed Workloads and Its Application in Evaluating Database Schemas | | |
| 4 | Combined Transaction Processing and Reporting Benchmark | 65 |
| 4.1 | Creation of a Hybrid Benchmark | 66 |
| 4.2 | The Benchmark Scenario | 67 |
| 4.2.1 | The Order-to-Cash Process | 69 |
| 4.2.2 | Conceptual Data Model and Database Schema | 70 |
| 4.3 | The Benchmark Queries | 74 |
| 4.3.1 | Transactions | 74 |
| 4.3.2 | Analytical Queries | 79 |
| 4.3.3 | CBTR Query Shares and Database Access | 83 |
| 4.4 | CBTR Measures and Parameters | 84 |
| 4.4.1 | The Throughput and Response Time Measures | 85 |
| 4.4.2 | Scaling | 85 |
| 4.4.3 | Workload Mix | 87 |
| 4.5 | CBTR and the Benchmark Properties | 89 |
| 4.6 | Summary | 91 |
| 5 | Database Schema Variants for Mixed OLTP and OLAP | 93 |
| 5.1 | Database Design Variation Levels | 94 |
| 5.2 | Database Schema Variants | 96 |
| 5.2.1 | Document-Oriented Schema | 97 |
| 5.2.2 | Snowflake Schema | 99 |
| 5.2.3 | Third Normal Form Schema Variant | 102 |
| 5.3 | Summary | 107 |
| | | |
| Part III Implementation, Evaluation, and Discussion | | |
| 6 | The CBTR Tool Chain | 111 |
| 6.1 | The Benchmark Run | 111 |
| 6.2 | Visualization of Results | 115 |
| 6.3 | Limitations and Opportunities | 118 |
| 6.4 | Summary | 119 |
| 7 | Evaluation of Mixing the Workload and Variation of the Database Schema | 121 |
| 7.1 | General Test Setup | 121 |
| 7.2 | Impact of Adding OLAP to OLTP | 122 |
| 7.3 | Impact of Database Schema Variation | 124 |

- 7.4 Database Schemas Under Varying Workload Mixes 129
- 7.5 Summary 131
- 8 Conclusion** 133
 - 8.1 Discussion 135
 - 8.2 Future Work 137

- A Related Activities and Publications** 139

- B Implementation** 141

- C Evaluation Results** 145

- Bibliography** 153



<http://www.springer.com/978-3-642-38069-3>

Benchmarking Transaction and Analytical Processing
Systems

The Creation of a Mixed Workload Benchmark and its
Application

Bog, A.

2014, XIII, 164 p., Hardcover

ISBN: 978-3-642-38069-3