Experiment Run Statistics

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1 Total Run Time Statistics

DBMS	Exhaustive	OnePass	Total Hours per DBMS
DB2	664.87	1069.38	1734.25
MySQL	1468.69	2457.77	3926.46
Oracle	417.93	2579.33	2997.26
Postgres	204.86	2334.36	2539.22
Total Hours	11197.19 (466.55 days = 15.55 months = 1.28 years)		

Table 1: Total Run Duration

2 Prior Timing Methodology

The prior protocol only uses *measured time* in Java per Q@C.

Percentage of Strict Monotonicity Violation	6.38% (121719/1906745)

Table 2: Strict Monotonicity Violations by Prior Timing Methodology

3 Step Size and Statistics by New Timing Protocol

We first provide background information of queries and query instances, and subsequently present each step size and statistics of our runs used in our analyses.

3.1 Background

1. Queries

   We generated 10 query sets each having 100 queries. Out of the query sets, in our analysis, a total of 8 sets are used for experiments concerning a variable table without primary key. Regarding primary key experiments, we extracted from each of the first six query sets a total of 230 queries having joins on primary key, in addition to 40 queries from the last four query sets. Thus, the total number of queries used in our analysis is **1,190** = 8 (query sets) × 100 (queries per set) + 230 (primary key queries) × 6 (the first six query sets) + 40 (primary key queries) × 4 (the last four query sets).

2. Query Instances

   A *query instance* is defined by the following factors: 1) one of the queries generated, 2) the query is on a variable with primary key or not, and 3) it is run on which DBMS. For instance, suppose that queries 1 and 2 involved both the same variable table with and without primary key, and they ran on the following DBMSes - DB2, MySQL, Oracle and PostgreSQL. Then, the total query instances derived from two queries are 16 = 2 (queries) × 2 (primary key or non-primary key cases) × 4 (DBMSes).

3.2 Exhaustive Analysis of Monotonicity

DBMS	Hours
DB2	174.25
MySQL	1109.923
Oracle	229.45
Postgres	158.32
Total Hours	1671.943 (69.66 Days = 2.32 months)

Table 3: Total Run Duration

DBMS	*Experiment Sets*	*Run IDs (Labshelf)*	*# of Queries*
DB2	10q-1,10q-2,10q-3,10q-4,10q-5	610,615,616,617,618 (6.0)	50
MySQL	2q-1,2q-2,2q-3,2q-4,2q-5	32,89,95 (5.19), 611,614 (6.0)	10
Oracle	10q-1,10q-2,10q-3,10q-4,10q-5	16,22,33,37,42 (5.19)	50
Postgres	10q-1,10q-2,10q-3,10q-4,10q-5	4,17,24,34,35 (5.19)	50
Total Query Instances	160		
Total Q@Cs	32,000		
Total QEs	320,000		

Table 4: Information about Queries Used in Exhaustive Analysis of Monotonicity

Number of Missing Queries	0
Number of Process Info Failures	0
Number of Unique Plan Violations	0

Table 5: Overall sanity checks

Percentage of DBMS Time Violations	0.23% (749/320000)
Percentage of Zero Query Time Violations	0.068% (218/320000)
Percentage of Query Time Violations	0.85% (2718/320000)
Percentage of No Query Process Violations	2.07% (6622/320000)
Percentage of Other Query Process Violations	0%
Percentage of Other Utility Process Violations	0%

Table 6: Query execution sanity checks

Amount of Variance in calculated times across all Q@Cs	1.36% (436.7/32000)
Percentage of Excessive Var. in Query Time	0.04% (14/32000)
Percentage of Strict Monotonicity Violation	1.80% (34399/1906745)
Percentage of Relaxed Monotonicity Violation	0.98% (18767/1906745)

Table 7: Q@C sanity checks

At Start of Step 2	32,000 Q@Cs
At Start of Step 2	320,000 QEs
After Step 2-(i)	310,330 QEs
After Step 2-(ii)	256,340 QEs
After Step 2-(iii)	255,539 QEs
After Step 2-(iv)	252,692 QEs (21.03% dropped)
At Start of Step 3	29,922 Q@Cs
After Step 3-(i)	29,922 Q@Cs
After Step 3-(ii)	29,629 Q@Cs
After Step 3-(iii)	27,948 Q@Cs (12.66% dropped)

Table 8: The number of Query Executions (QEs) and Q@Cs remaining after each sub-step

Total Query Instances	158 (98.75% survived)
Total Q@Cs	27,948
Amount of Variance in calculated times across all Q@Cs	0.80% ((159.1+64.7)/27948)
Percentage of Excessive Var. in Query Time	0.02% (5/27948)
Percentage of Strict Monotonicity Violations	1.55% (24527/1582867)
Percentage of Relaxed Monotonicity Violations	0.61% (9718/1582867)

Table 9: Post (Q@C) sanity checks

3.3 Exploratory Analysis

DBMS	Hours
DB2	8.43
MySQL	32.79
Oracle	375.03
Postgres	142.59
Total Hours	558.84 (23.29 Days)

Table 10: Total Run Duration

DBMS	*Experiment Sets*	*Run IDs (Labshelf)*	*# of Queries*
DB2	10q-1,pk-10q-1	473,491 (6.0)	20
MySQL	10q-1,pk-10q-1	475,517 (6.0)	20
Oracle	100q-1,100q-2,100q-3,100q-4,100q-5,100q-6,pk-10q-1	57,65,91,94 (5.19), 2,61 (5.20), 490 (6.0)	610
Postgres	20q-1,20q-2,20q-3,20q-4,20q-5,20q-6,pk-10q-1	92 (5.19), 41,4,55,10,13 (5.20), 525 (6.0)	130
Total Query Instances	780		
Total Q@Cs	8,842		
Total QEs	88,420		

Table 11: Information about Queries Used in Exploratory Analysis

Number of Missing Queries	0
Number of Process Info Failures	0
Number of Unique Plan Violations	0

Table 12: Overall sanity checks

Percentage of DBMS Time Violations	0.01% (7/88420)
Percentage of Zero Query Time Violations	0.04% (36/88420)
Percentage of Query Time Violations	0.07% (60/88420)
Percentage of No Query Process Violations	0.26% (228/88420)
Percentage of Other Query Process Violations	0%
Percentage of Other Utility Process Violations	0%

Table 13: Query execution sanity checks

Percentage of Excessive Var. in Query Time	0.01% (1/8842)
Percentage of Strict Monotonicity Violation	0.25% (126/50906)
Percentage of Relaxed Monotonicity Violation	0.03% (17/50906)

Table 14: Q@C sanity checks

At Start of Step 2	8,842 Q@Cs
At Start of Step 2	88,420 QEs
After Step 2-(i)	88,088 QEs
After Step 2-(ii)	72,000 QEs
After Step 2-(iii)	71,448 QEs
After Step 2-(iv)	71,435 QEs (19.21% dropped)
At Start of Step 3	8,735 Q@Cs
After Step 3-(i)	8,735 Q@Cs
After Step 3-(ii)	8,690 Q@Cs
After Step 3-(iii)	8,171 Q@Cs (7.60% dropped)

Table 15: The number of Query Executions (QEs) and Q@Cs remaining after each sub-step

Total Query Instances	683 (88.84% survived)
Total Q@Cs	8,171
Percentage of Excessive Var. in Query Time	0.01% (1/8171)
Percentage of Strict Monotonicity Violations	0.36% (166/45741)
Percentage of Relaxed Monotonicity Violations	0.05% (24/45741)

Table 16: Post (Q@C) sanity checks

3.4 Confirmatory Analysis

DBMS	Hours
DB2	404.75
MySQL	2006.47
Oracle	910.04
Postgres	988.60
Total Hours	4309.86 (179.58 days = 6 months))

Table 17: Total Run Duration

DBMS	*Experiment Sets*	*Run IDs (Labshelf)*	*# of Queries*
DB2	100q-1,100q-2,100q-3,100q-4,100q-5,100q-6,100q-7,100q-8, pk-230q,pk-160q	121,122,123,124,125,126 (5.20), 553,557 (6.0), 127 (5.20), 327 (6.0)	1,190
MySQL	100q-1,100q-2,100q-3,100q-4,100q-5,100q-6,100q-7,100q-8, pk-230q,pk-160q	23,54,90 (5.19), 5,6,34 (5.20), 550,558 (6.0), 99 (5.20), 330 (6.0)	1,190
Oracle	100q-1,100q-2,100q-3,100q-4,100q-5,100q-6,100q-7,100q-8, pk-230q,pk-160q	166,167,168,181,202,203,569,554 (6.0), 97 (5.20),319 (6.0)	1,190
Postgres	100q-1,100q-2,100q-3,100q-4,100q-5,100q-6,100q-7,100q-8, pk-230q,pk-160q	161,201 (5.20), 286 (6.0), 3 (5.3), 287,290,551,556 (6.0), 98 (5.20), 326 (6.0)	1,190
Total Query Instances	4,760		
Total Q@Cs	57,978		
Total QEs	579,780		

Table 18: Information about Queries Used in Confirmatory Analysis

Number of Missing Queries	0
Number of Process Info Failures	0
Number of Unique Plan Violations	0

Table 19: Overall sanity checks

Percentage of DBMS Time Violations	0.01% (77/579780)
Percentage of Zero Query Time Violations	0.01% (45/579780)
Percentage of Query Time Violations	0.49% (2859/579780)
Percentage of No Query Process Violations	0.15% (861/579780)
Percentage of Other Query Process Violations	0%
Percentage of Other Utility Process Violations	0%

Table 20: Query execution sanity checks

Percentage of Excessive Var. in Query Time	0.06% (36/57978)
Percentage of Strict Monotonicity Violation	0.47% (1529/321945)
Percentage of Relaxed Monotonicity Violation	0.09% (304/321945)

Table 21: Q@C sanity checks

At Start of Step 2	57,978 Q@Cs
At Start of Step 2	579,780 QEs
After Step 2-(i)	575,397 QEs
After Step 2-(ii)	413,965 QEs
After Step 2-(iii)	409,917 QEs
After Step 2-(iv)	408,226 QEs (29.59% dropped)
At Start of Step 3	52,171 Q@Cs
After Step 3-(i)	52,171 Q@Cs
After Step 3-(ii)	51,716 Q@Cs
After Step 3-(iii)	44,608 Q@Cs (23.06% dropped)

Table 22: The number of Query Executions (QEs) and Q@Cs remaining after each sub-step

Total Query Instances	3,101 (65.15% survived)
Total Q@Cs	44,608
Percentage of Excessive Var. in Query Time	0.002% (1/44608)
Percentage of Strict Monotonicity Violations	1.22% (total: 3032/248135) (pk only: 0.53% = 309/58764)
Percentage of Relaxed Monotonicity Violations	0.20% (total: 379/248135) (pk only: 0.09% = 54/58764)

Table 23: Post (Q@C) sanity checks