

# TPC-H Demo Report

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## **Abstract**

DBMS-Benchmark is an application-level blackbox benchmark tool for DBMS. It connects to a given list of DBMS and runs a given list of benchmark queries. Currently JDBC and SQL is supported. The script can process per query or per connection. Query runs can be parametrized and queries can be randomized. For each query it computes some statistics. If a query fails, the script collects the error message. The received result sets can be compared by content, hash code or size. Optionally some reports are generated.

This is a demo report.

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# 1 Some TPC-H Demo Queries - SF=1 at Clouds

This test report contains some demo queries inspired by the TPC-H Benchmark.

Report generated: 2019-08-23 10:13:35.190433

Code: 1566505743

Timeout: Nones

Number of parallel client processes (global setting): 4

Number of runs per client connection (global setting): 4

## 1.1 Terminology

This report covers results from sending queries to DBMS in several benchmark runs.

- **Connection:**

This means a DBMS server in a specific configuration.

- **Query:**

This means a single query statement.

- **Benchmark run:**

This means sending a query to a connection (and receiving a result set) once.

- **Timer:**

There are three timers: Connection, execution and transfer.

Each one measures the time of a specific part of a benchmark run.

- **Sum of times:**

This is based on the sum of times of all single benchmark test runs. Measurements start before each benchmark run and stop after the same benchmark run has been finished. Parallel benchmark runs should not slow down in an ideal situation.

- **Total times:**

This is based on the times each connection is queried in total. Measurement starts before first benchmark run and stops after the last benchmark run has been finished. Parallel benchmarks should speed up the total time in an ideal situation.

## 1.2 Statistics

$$\text{Mean} : \mu := \frac{1}{n} \sum_i x_i$$

$$\text{Standard deviation} : \sigma := \sqrt{\frac{1}{n-1} \sum_i (x_i - \mu)^2}$$

$$\text{Coefficient of variation} : cv := \frac{\sigma}{\mu}$$

$$\text{Quartile coefficient of dispersion} : qcod := \frac{Q_3 - Q_1}{Q_3 + Q_1}$$

$$\text{Interquartile range} : iqr := Q_3 - Q_1$$

## 1.3 Database Management Systems

### 1.3.1 DBMS C

- **Parallel Clients:** 4
- **Runs per Connection:** Unlimited
- **Timeout:** 1200
- **CPU:** CPU: Intel(R) Xeon(R) Platinum 8175M CPU @ 2.50GHz
- **Cores:** 16
- **RAM:** 128.0 GB
- **GPU:**
- **Host:** 4.4.0-1090-aws
- **Docker Disk Space Used:** 69G
- **Instance:** r5d.4xlarge
- **Time Ingest:** 27,770.76ms = 00:00:28
- **Time Benchmarks:** 162,002.31ms = 00:02:43
- **Time Total:** 189,773.07ms = 00:03:10
- **Price:** \$0.07 (\$1.38/h)

### 1.3.2 DBMS D

- **Parallel Clients:** 4
- **Runs per Connection:** Unlimited
- **Timeout:** 1200
- **CPU:** CPU: Intel(R) Xeon(R) Platinum 8175M CPU @ 2.50GHz
- **Cores:** 16
- **RAM:** 128.0 GB
- **GPU:**
- **Host:** 4.4.0-1090-aws
- **Docker Disk Space Used:** 69G
- **Instance:** r5d.4xlarge
- **Time Ingest:** 70,592.26ms = 00:01:11
- **Time Benchmarks:** 1,257,099.09ms = 00:20:58
- **Time Total:** 1,327,691.36ms = 00:22:08
- **Price:** \$0.51 (\$1.38/h)

### 1.3.3 GPU DBMS E

- **Parallel Clients:** 4
- **Runs per Connection:** Unlimited
- **Timeout:** 1200
- **CPU:** CPU: Intel(R) Xeon(R) CPU E5-2686 v4 @ 2.30GHz
- **Cores:** 4
- **RAM:** 64.0 GB
- **GPU:** 1 x Tesla K80
- **CUDA:** NVIDIA-SMI 410.79 Driver Version: 410.79 CUDA Version: 10.0
- **Host:** 4.4.0-1075-aws
- **Docker Disk Space Used:** 78G
- **Instance:** p2.xlarge
- **Time Ingest:** 29,766.31ms = 00:00:30
- **Time Benchmarks:** 161,286.46ms = 00:02:42
- **Time Total:** 191,052.77ms = 00:03:12
- **Price:** \$0.07 (\$1.33/h)

#### 1.3.4 GPU DBMS F

- **Parallel Clients:** 4
- **Runs per Connection:** Unlimited
- **Timeout:** 1200
- **CPU:** CPU: Intel(R) Xeon(R) CPU E5-2686 v4 @ 2.30GHz
- **Cores:** 8
- **RAM:** 61.0 GB
- **GPU:** 1 x Tesla V100-SXM2-16GB
- **CUDA:** NVIDIA-SMI 410.79 Driver Version: 410.79 CUDA Version: 10.0
- **Host:** 4.4.0-1075-aws
- **Docker Disk Space Used:** 75G
- **Instance:** p3.2xlarge
- **Time Ingest:** 16,295.51ms = 00:00:17
- **Time Benchmarks:** 160,360.68ms = 00:02:41
- **Time Total:** 176,656.19ms = 00:02:57
- **Price:** \$0.19 (\$3.82/h)

#### 1.3.5 In-Memory A

- **Parallel Clients:** 4
- **Runs per Connection:** Unlimited
- **Timeout:** 1200
- **CPU:** CPU: Intel(R) Xeon(R) Platinum 8175M CPU @ 2.50GHz
- **Cores:** 8
- **RAM:** 64.0 GB
- **GPU:**
- **Host:** 4.4.0-1090-aws
- **Docker Disk Space Used:** 69G
- **Instance:** r5d.2xlarge
- **Time Ingest:** 29,059.49ms = 00:00:30
- **Time Benchmarks:** 141,860.55ms = 00:02:22
- **Time Total:** 170,920.04ms = 00:02:51
- **Price:** \$0.03 (\$0.69/h)

#### 1.3.6 In-Memory B

- **Parallel Clients:** 4
- **Runs per Connection:** Unlimited
- **Timeout:** 1200
- **CPU:** CPU: Intel(R) Xeon(R) Platinum 8175M CPU @ 2.50GHz
- **Cores:** 16
- **RAM:** 128.0 GB
- **GPU:**
- **Host:** 4.4.0-1090-aws
- **Docker Disk Space Used:** 68G
- **Instance:** r5d.4xlarge
- **Time Ingest:** 27,156.48ms = 00:00:28
- **Time Benchmarks:** 117,530.65ms = 00:01:58
- **Time Total:** 144,687.12ms = 00:02:25
- **Price:** \$0.06 (\$1.38/h)

## 2 Summary

### 2.1 Relative ranking based on the sum of times

For each query, the best DBMS is considered as gold standard = 100%. Based on their times, the other DBMS obtain a relative ranking factor. The next chart shows the geometric mean of factors per DBMS.

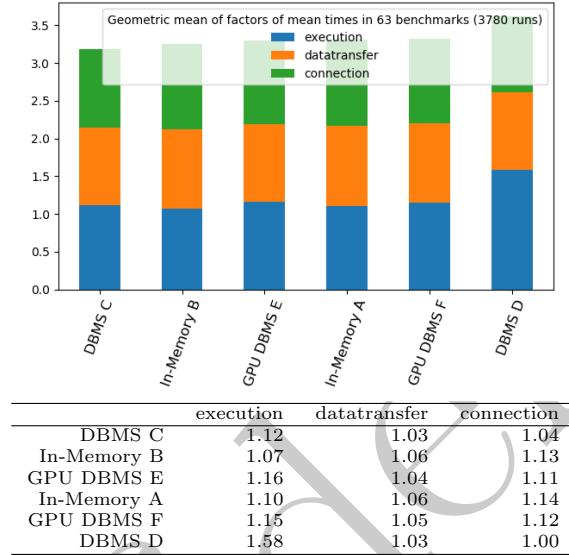


Figure 1: DBMS: Relative ranking

## 2.2 Absolute time of ingest

The next chart shows the total time of ingestion per DBMS.

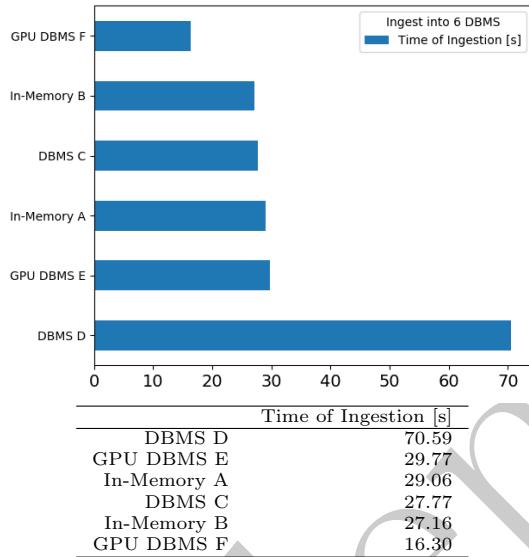


Figure 2: DBMS: Ingest

### 2.3 Average ranking based on the sum of times

We compute a ranking of DBMS for each query, from fastest to slowest. The next chart shows the average ranking per DBMS.

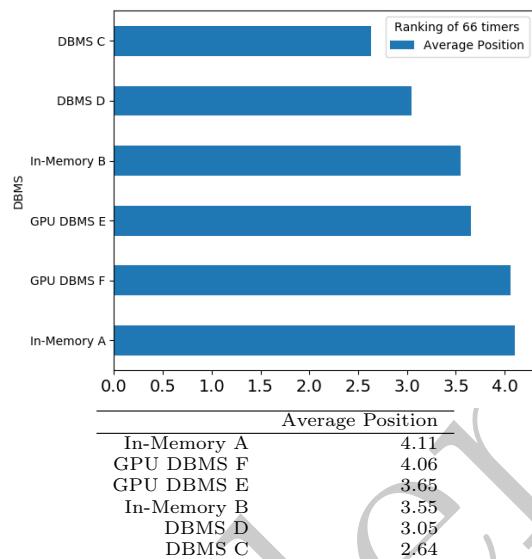


Figure 3: DBMS: Average ranking

## 2.4 Mean of times

The next chart shows the mean of query times per DBMS and per timer.

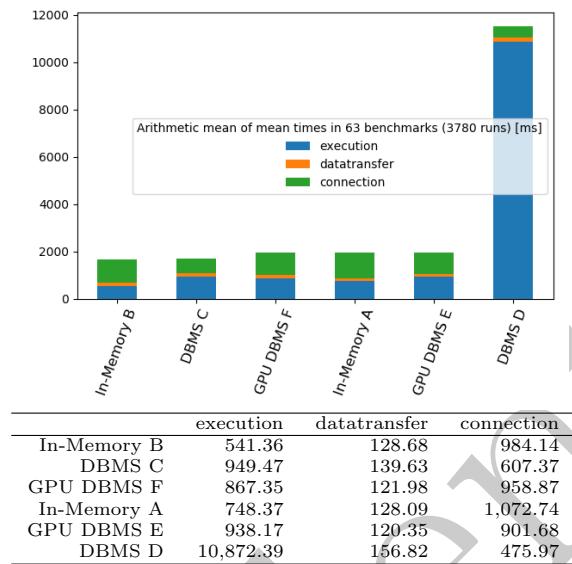


Figure 4: DBMS: Mean of times

### 3 Queries

#### 3.1 Total times

The next chart shows the total query time per DBMS and query.

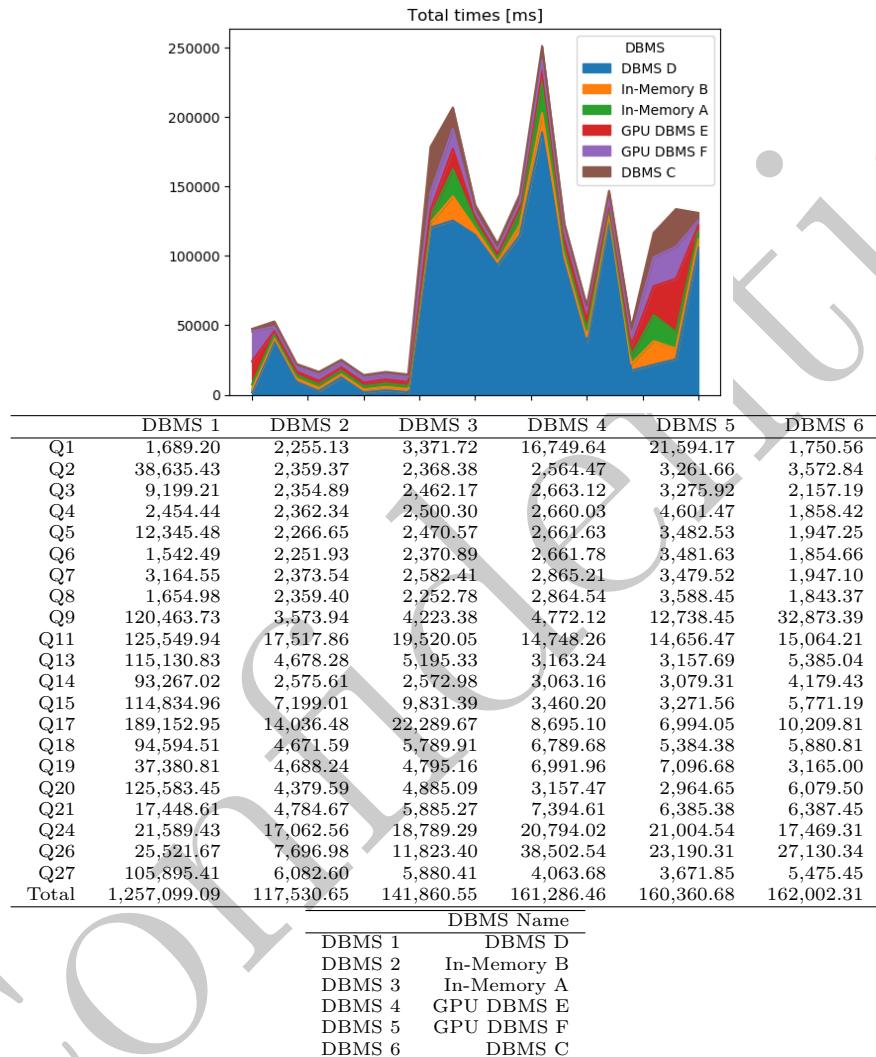
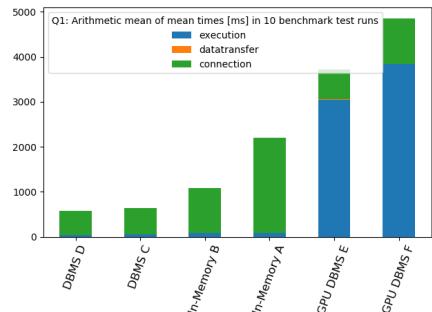


Figure 5: DBMS: Total times

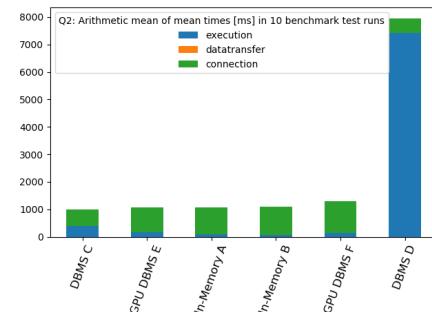
### 3.2 Mean of times per query

The next charts show the sums of query times per DBMS, timer and query.

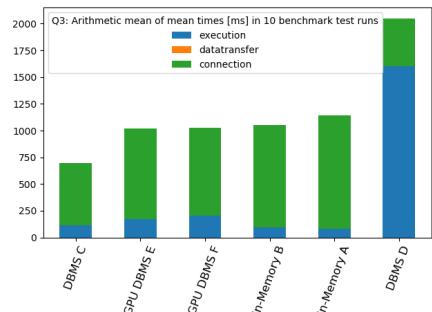
**Q1: Count rows in nation**



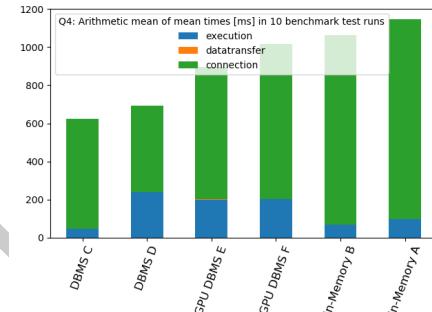
**Q2: Count rows in lineitem**



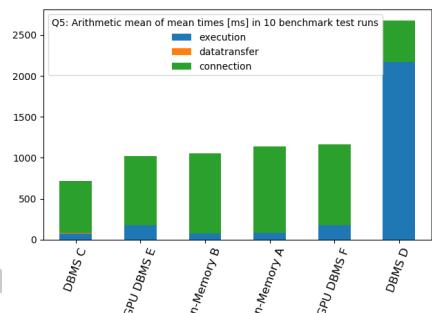
**Q3: Count rows in orders**



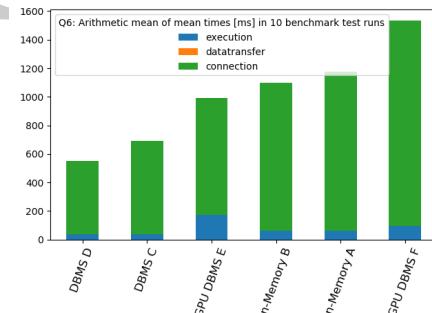
**Q4: Count rows in customer**



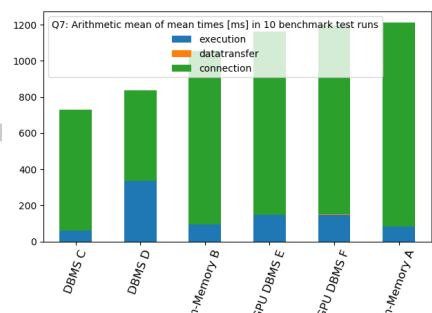
**Q5: Count rows in partsupp**



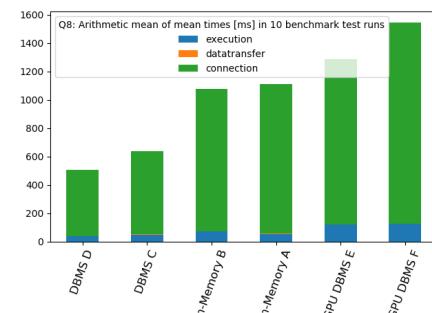
**Q6: Count rows in supplier**



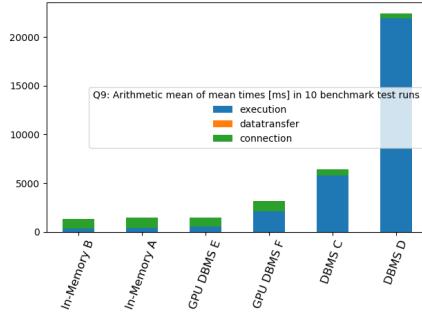
**Q7: Count rows in part**



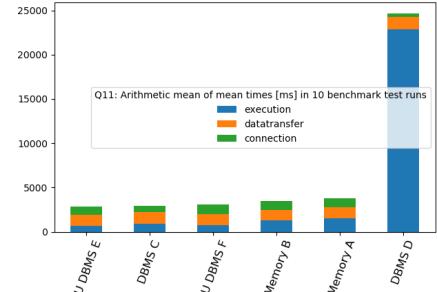
**Q8: Count rows in region**



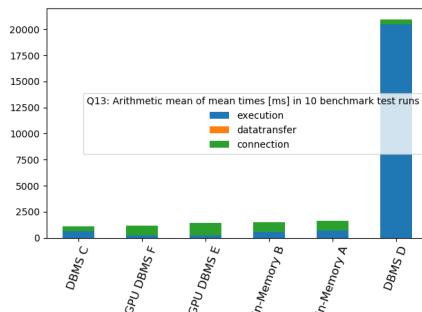
**Q9: Pricing Summary Report (TPC-H Q1)**



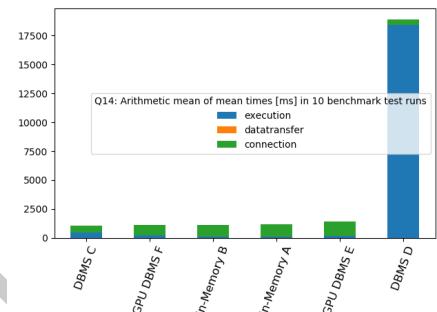
**Q11: Shipping Priority (TPC-H Q3)**



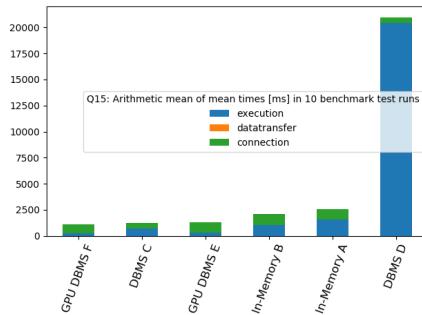
**Q13: Local Supplier Volume (TPC-H Q5)**



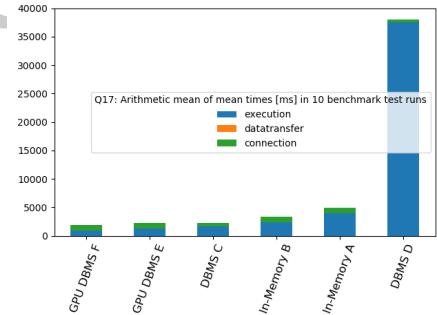
**Q14: Forecasting Revenue Change (TPC-H Q6)**



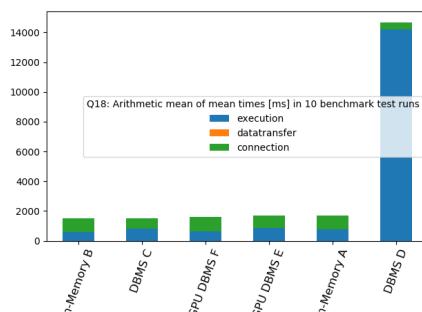
**Q15: Forecasting Revenue Change (TPC-H Q7)**



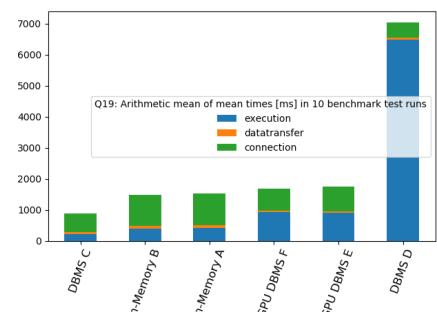
**Q17: Product Type Profit Measure (TPC-H Q9)**



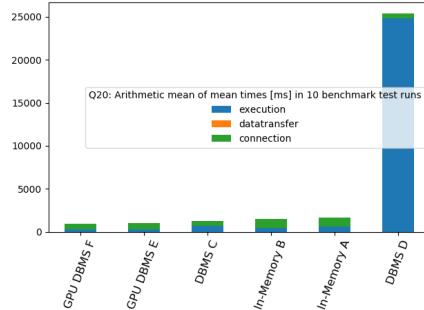
**Q18: Forecasting Revenue Change (TPC-H Q10)**



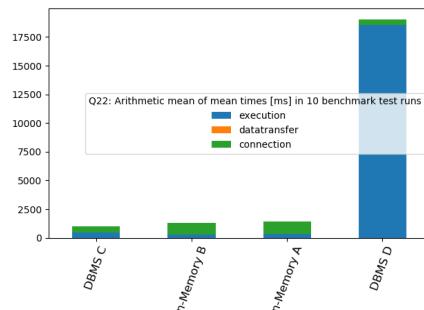
**Q19: Important Stock Identification (TPC-H Q11)**



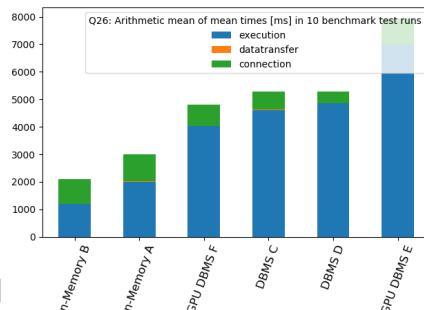
**Q20: Shipping Modes and Order Priority (TPC-H Q12)**



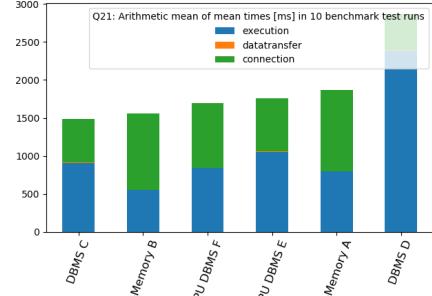
**Q22: Forecasting Revenue Change (TPC-H Q14)**



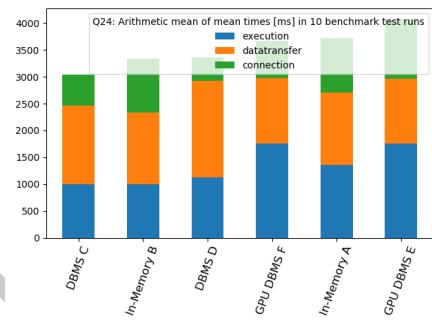
**Q26: Large Volume Customer (TPC-H Q18)**



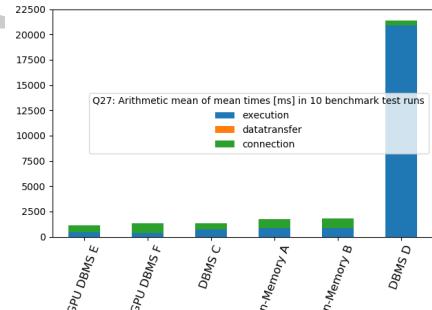
**Q21: Customer Distribution (TPC-H Q13)**



**Q24: Parts/Supplier Relationship (TPC-H Q16)**



**Q27: Discounted Revenue (TPC-H Q19)**



### 3.3 Query 1: Count rows in nation

Total Times:

- In-Memory A: 3,371.72ms = 00:00:04
- In-Memory B: 2,255.13ms = 00:00:03
- DBMS C: 1,750.56ms = 00:00:02
- DBMS D: 1,689.20ms = 00:00:02
- GPU DBMS E: 16,749.64ms = 00:00:17
- GPU DBMS F: 21,594.17ms = 00:00:22

```
SELECT COUNT(*) c FROM nation
```

Results

### 3.3.1 Hardware Metrics

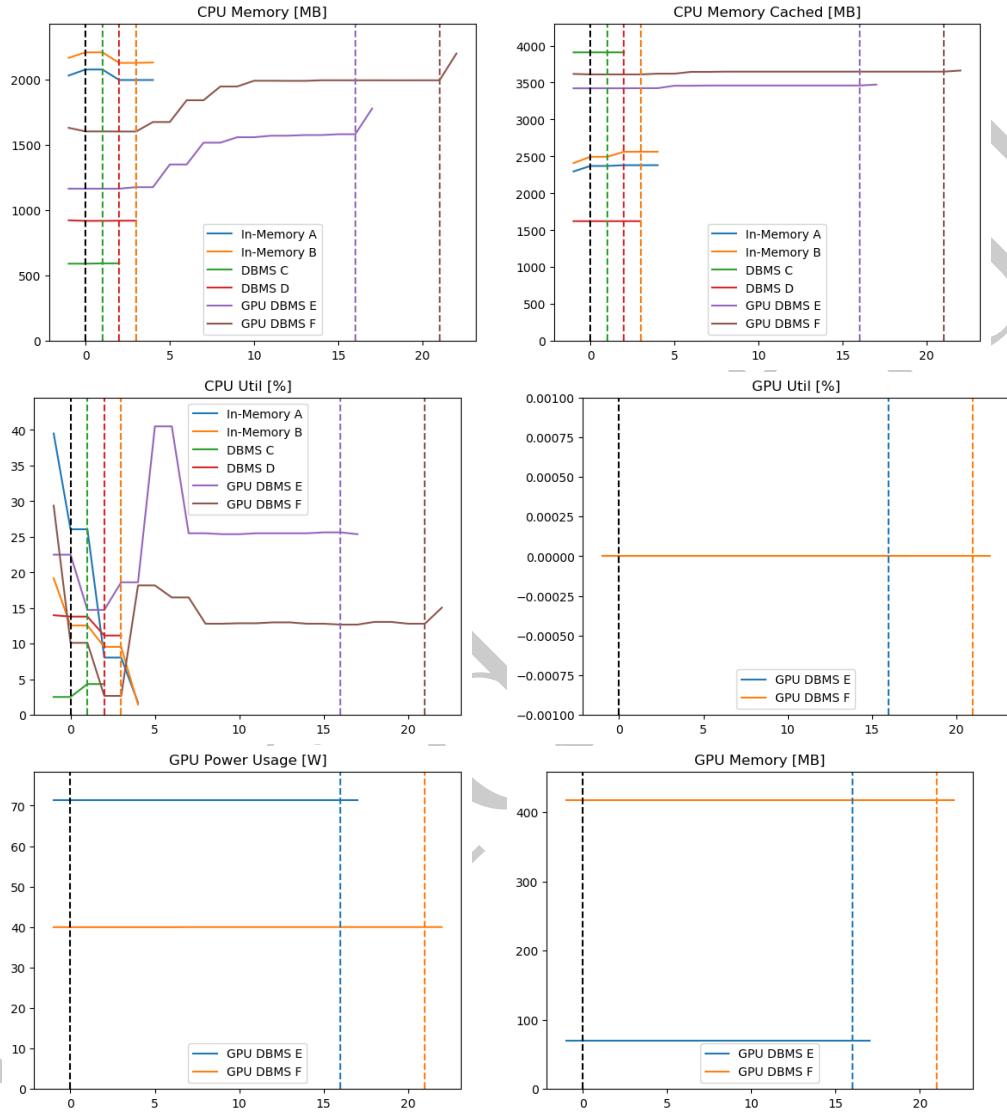


Figure 6: Query 1: Server Hardware Metrics

### 3.3.2 Time execution

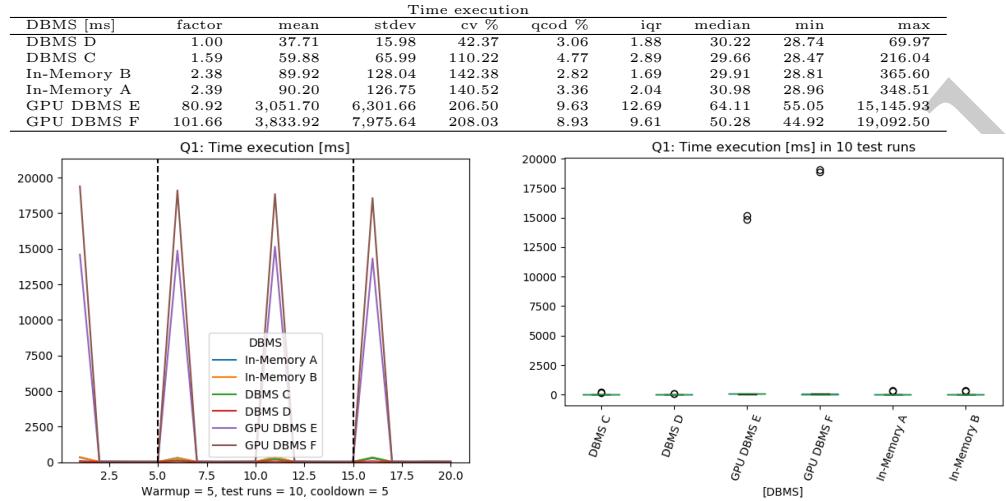


Figure 7: Query 1: Time execution

### 3.3.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
In-Memory A	1.00	0.49	0.75	153.05	27.20	0.08	0.14	0.09	1.94
DBMS C	1.15	0.56	0.96	170.71	28.46	0.08	0.14	0.09	2.85
In-Memory B	1.26	0.61	1.06	172.25	19.61	0.05	0.12	0.09	3.02
GPU DBMS E	1.31	0.64	1.14	178.01	30.43	0.07	0.14	0.08	3.25
GPU DBMS F	1.48	0.72	1.33	184.02	6.74	0.02	0.11	0.08	3.79
DBMS D	1.65	0.81	1.46	180.74	11.07	0.03	0.13	0.11	4.12

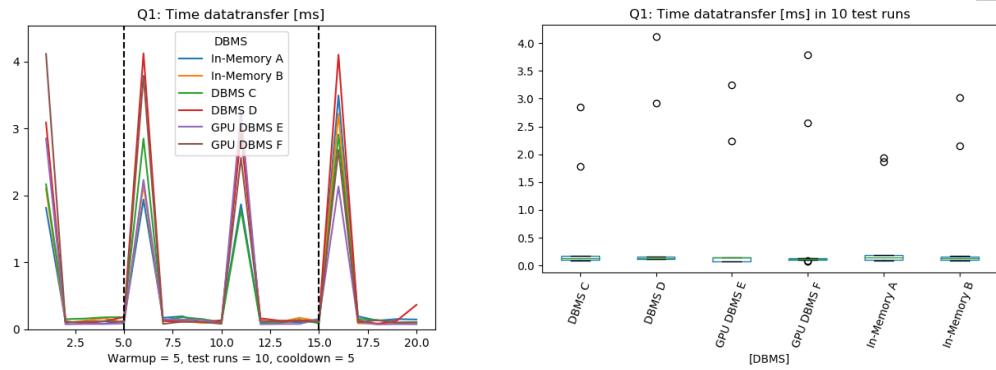


Figure 8: Query 1: Time datatransfer

### 3.3.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	539.85	78.75	14.59	13.84	149.41	539.85	465.14	614.55
DBMS C	1.06	572.03	86.87	15.19	14.41	164.82	572.03	489.62	654.44
GPU DBMS E	1.23	664.66	143.00	21.52	20.41	271.33	664.66	528.99	800.32
In-Memory B	1.85	997.69	3.00	0.30	0.29	5.70	997.69	994.84	1,000.54
GPU DBMS F	1.88	1,012.88	147.50	14.56	13.81	279.85	1,012.88	872.96	1,152.81
In-Memory A	3.92	2,117.78	10.88	0.51	0.49	20.64	2,117.78	2,107.45	2,128.10

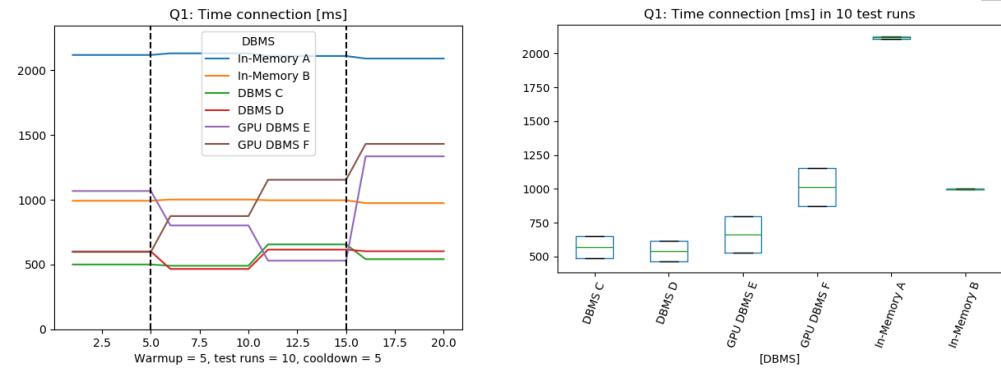


Figure 9: Query 1: Time connection

### 3.4 Query 2: Count rows in lineitem

Total Times:

- In-Memory A: 2,368.38ms = 00:00:03
- In-Memory B: 2,359.37ms = 00:00:03
- DBMS C: 3,572.84ms = 00:00:04
- DBMS D: 38,635.43ms = 00:00:39
- GPU DBMS E: 2,564.47ms = 00:00:03
- GPU DBMS F: 3,261.66ms = 00:00:04

```
SELECT COUNT(*) c FROM lineitem
```

Results

### 3.4.1 Hardware Metrics

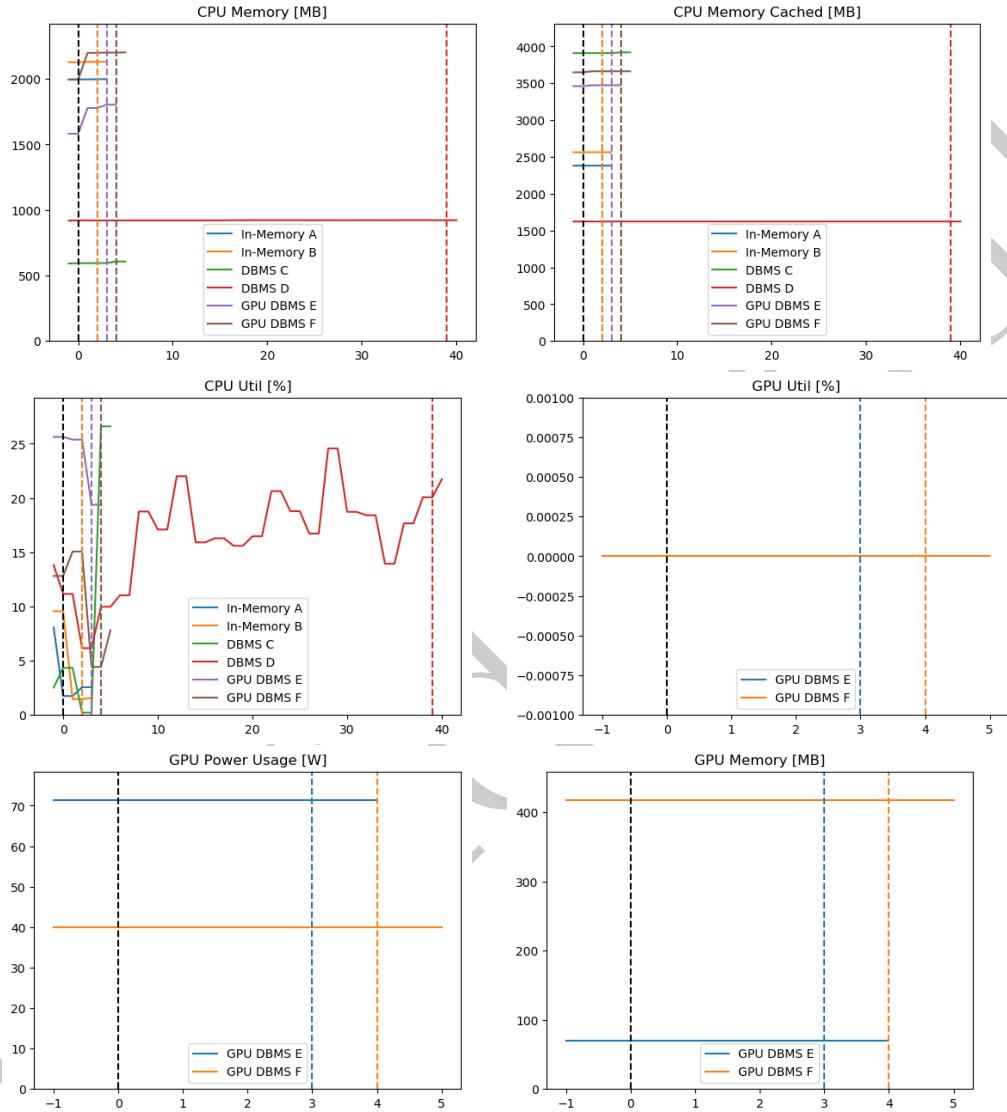


Figure 10: Query 2: Server Hardware Metrics

### 3.4.2 Time execution

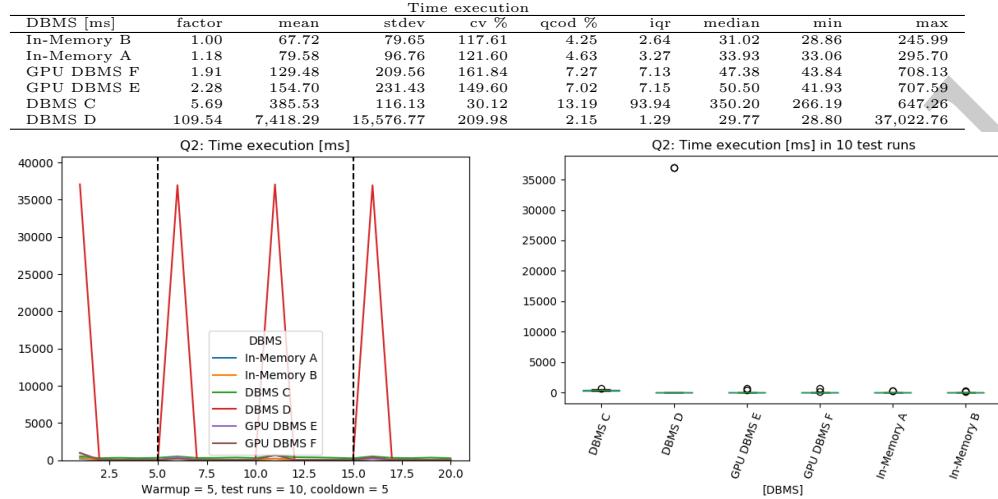


Figure 11: Query 2: Time execution

### 3.4.3 Time datatransfer

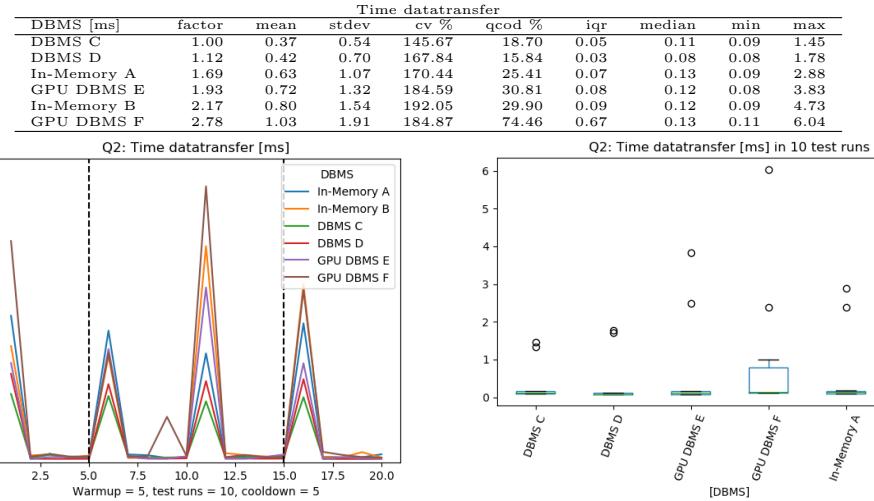


Figure 12: Query 2: Time datatransfer

### 3.4.4 Time connection

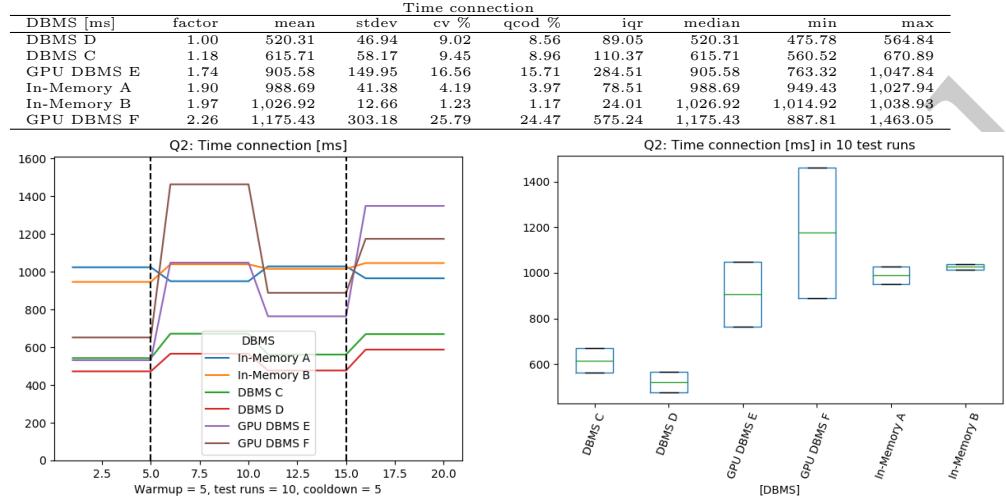


Figure 13: Query 2: Time connection

### 3.5 Query 3: Count rows in orders

Total Times:

- In-Memory A: 2,462.17ms = 00:00:03
- In-Memory B: 2,354.89ms = 00:00:03
- DBMS C: 2,157.19ms = 00:00:03
- DBMS D: 9,199.21ms = 00:00:10
- GPU DBMS E: 2,663.12ms = 00:00:03
- GPU DBMS F: 3,275.92ms = 00:00:04

```
SELECT COUNT(*) c FROM orders
```

Results

### 3.5.1 Hardware Metrics

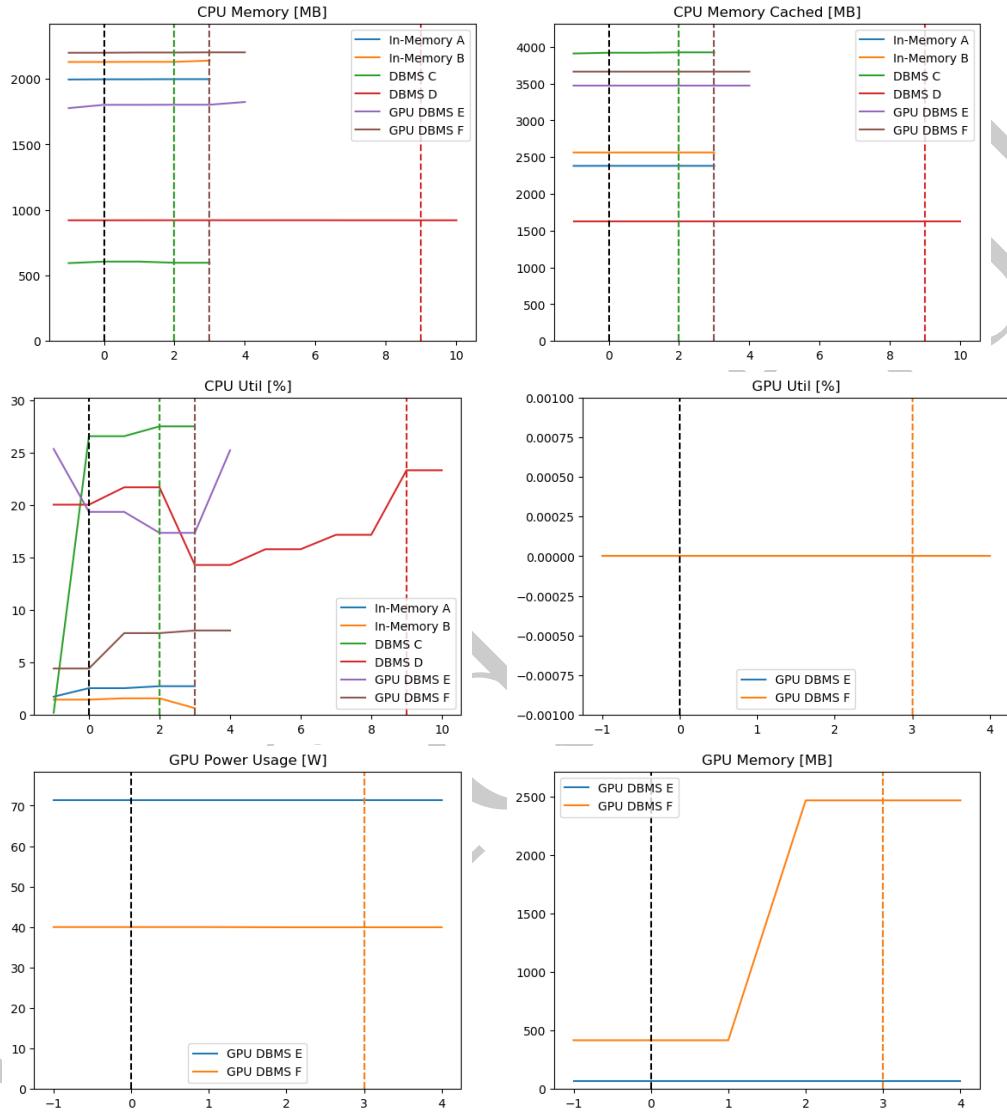


Figure 14: Query 3: Server Hardware Metrics

### 3.5.2 Time execution

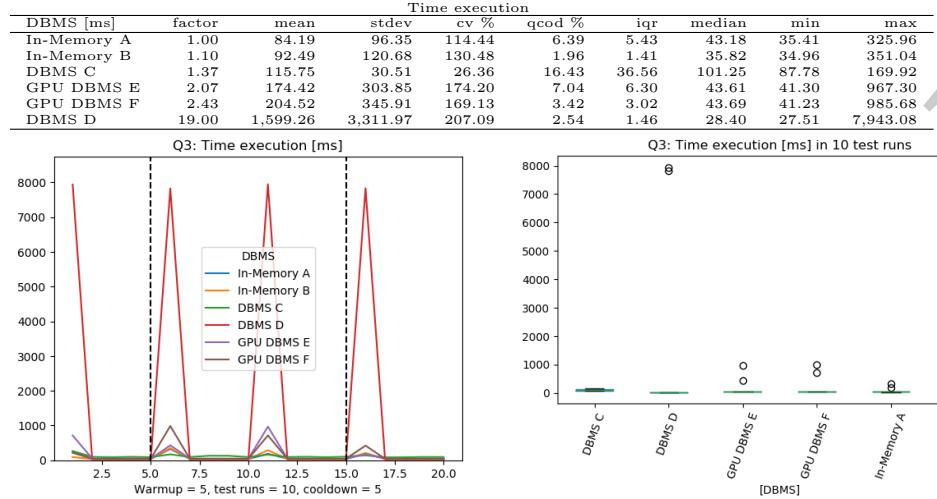


Figure 15: Query 3: Time execution

### 3.5.3 Time datatransfer

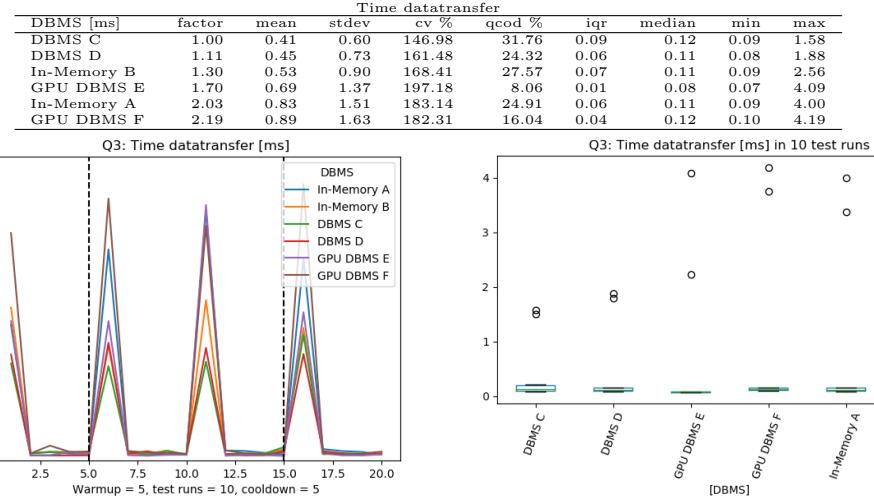


Figure 16: Query 3: Time datatransfer

### 3.5.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	446.03	57.38	12.86	12.20	108.86	446.03	391.60	500.46
DBMS C	1.29	576.95	4.73	0.82	0.78	8.98	576.95	572.47	581.44
GPU DBMS F	1.84	822.89	139.79	16.99	16.12	265.24	822.89	690.28	955.51
GPU DBMS E	1.89	841.21	284.66	33.84	32.10	540.11	841.21	571.15	1,111.27
In-Memory B	2.14	956.64	7.65	0.80	0.76	14.51	956.64	949.39	963.90
In-Memory A	2.38	1,060.62	65.24	6.15	5.84	123.78	1,060.62	998.72	1,122.51

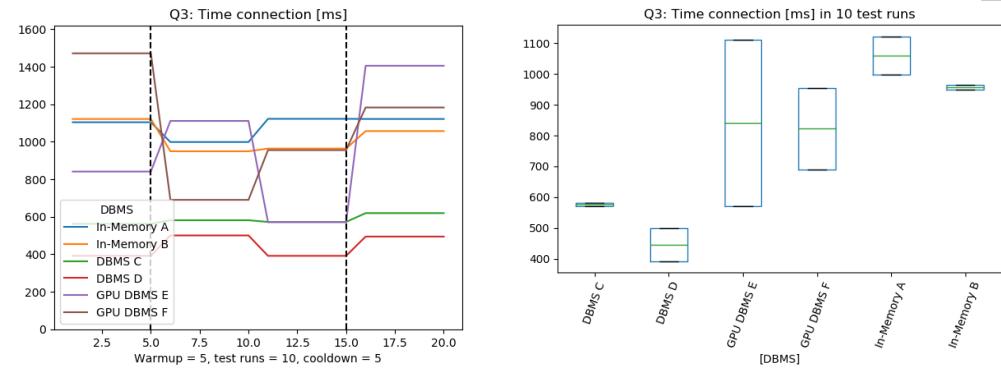


Figure 17: Query 3: Time connection

### 3.6 Query 4: Count rows in customer

Total Times:

- In-Memory A: 2,500.30ms = 00:00:03
- In-Memory B: 2,362.34ms = 00:00:03
- DBMS C: 1,858.42ms = 00:00:02
- DBMS D: 2,454.44ms = 00:00:03
- GPU DBMS E: 2,660.03ms = 00:00:03
- GPU DBMS F: 4,601.47ms = 00:00:05

```
SELECT COUNT(*) c FROM customer
```

Results

### 3.6.1 Hardware Metrics

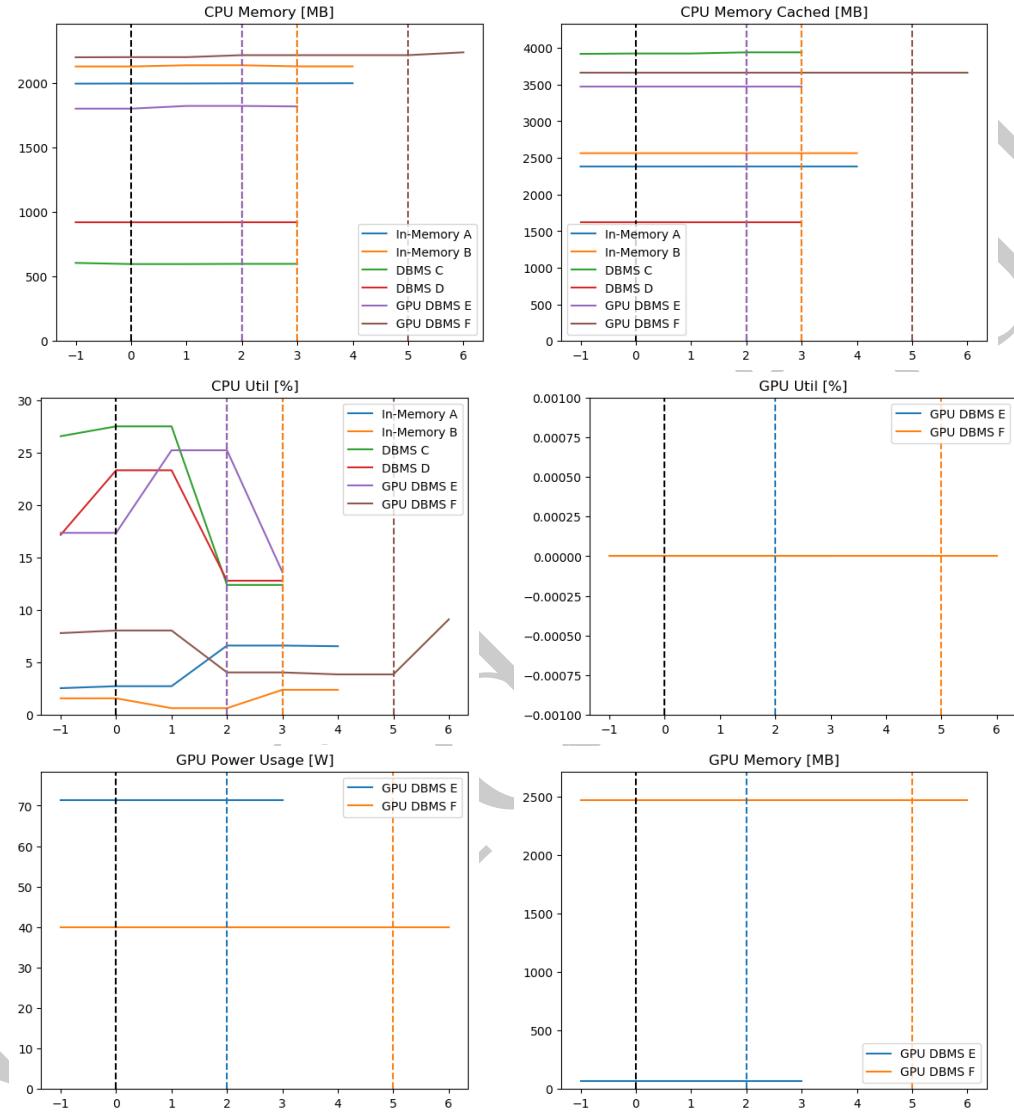


Figure 18: Query 4: Server Hardware Metrics

### 3.6.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS C	1.00	45.83	14.68	32.04	1.13	0.88	39.05	38.34	75.66
In-Memory B	1.45	66.40	65.86	99.18	1.31	0.94	35.87	33.98	211.60
In-Memory A	2.14	97.92	112.51	114.90	15.65	14.38	49.65	35.94	319.33
GPU DBMS E	4.37	200.25	343.04	171.30	7.07	6.00	40.93	37.74	983.73
GPU DBMS F	4.42	202.39	345.24	170.58	2.63	2.24	42.75	40.67	996.19
DBMS D	5.22	239.17	445.34	186.20	4.18	2.47	28.63	27.93	1,164.17

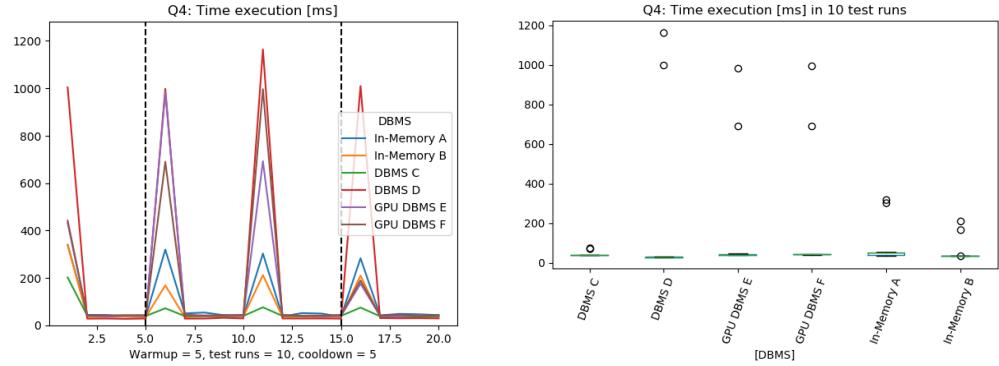


Figure 19: Query 4: Time execution

### 3.6.3 Time datatransfer

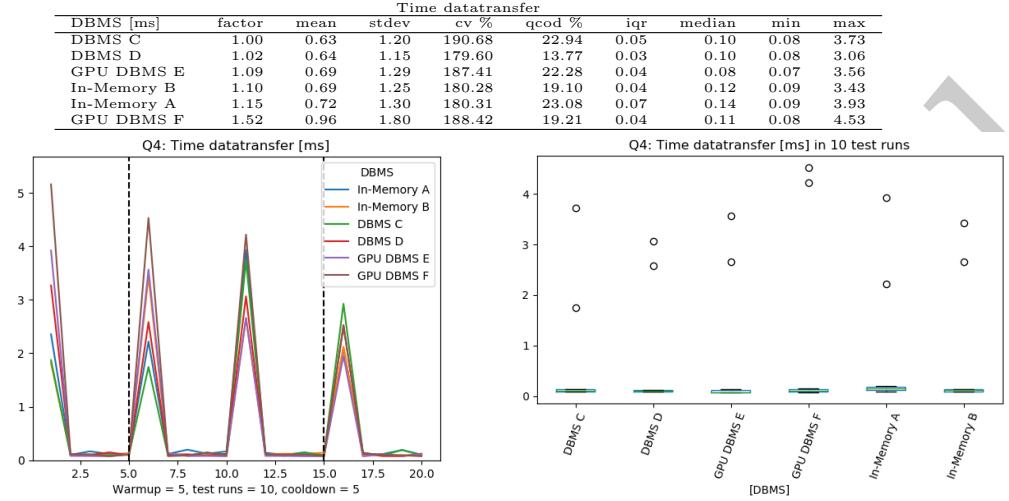


Figure 20: Query 4: Time datatransfer

### 3.6.4 Time connection

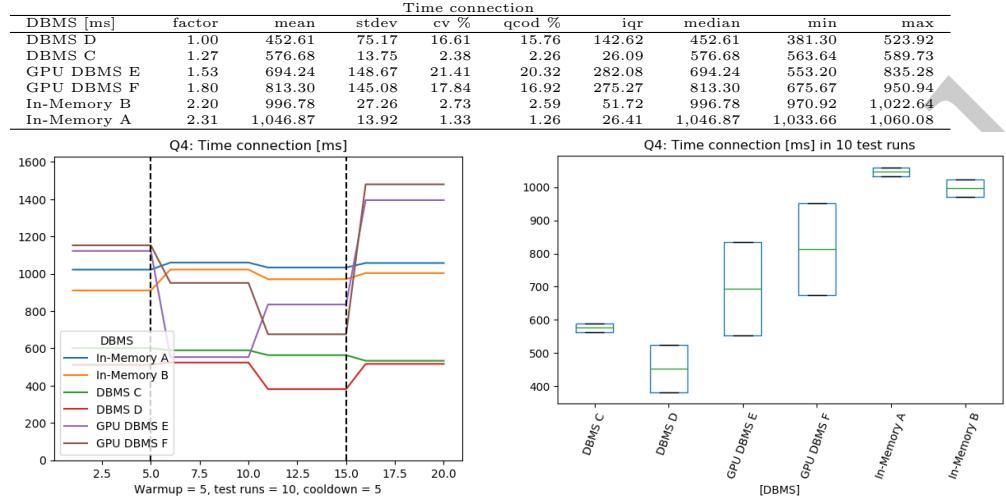


Figure 21: Query 4: Time connection

### 3.7 Query 5: Count rows in partsupp

Total Times:

- In-Memory A: 2,470.57ms = 00:00:03
- In-Memory B: 2,266.65ms = 00:00:03
- DBMS C: 1,947.25ms = 00:00:02
- DBMS D: 12,345.48ms = 00:00:13
- GPU DBMS E: 2,661.63ms = 00:00:03
- GPU DBMS F: 3,482.53ms = 00:00:04

```
SELECT COUNT(*) c FROM partsupp
```

Results

### 3.7.1 Hardware Metrics

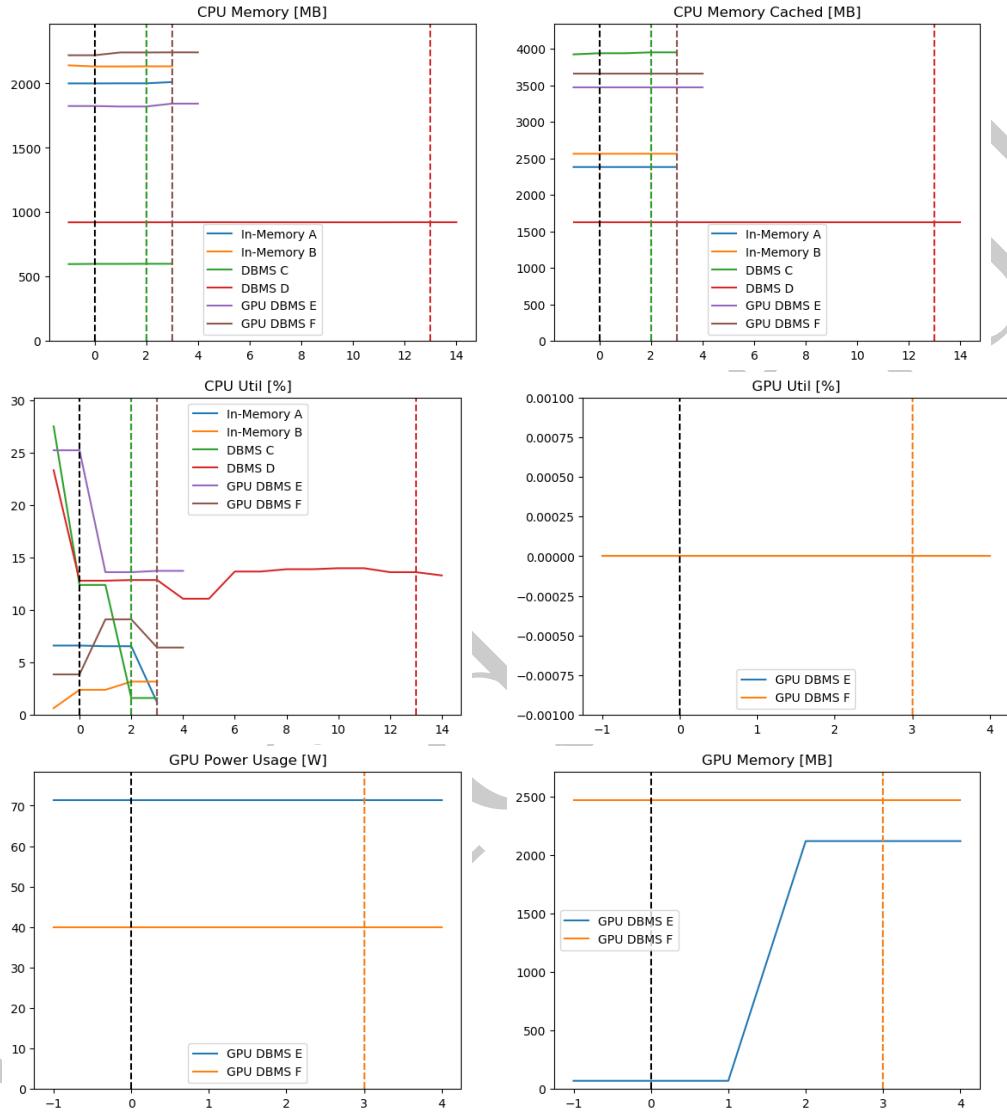


Figure 22: Query 5: Server Hardware Metrics

### 3.7.2 Time execution

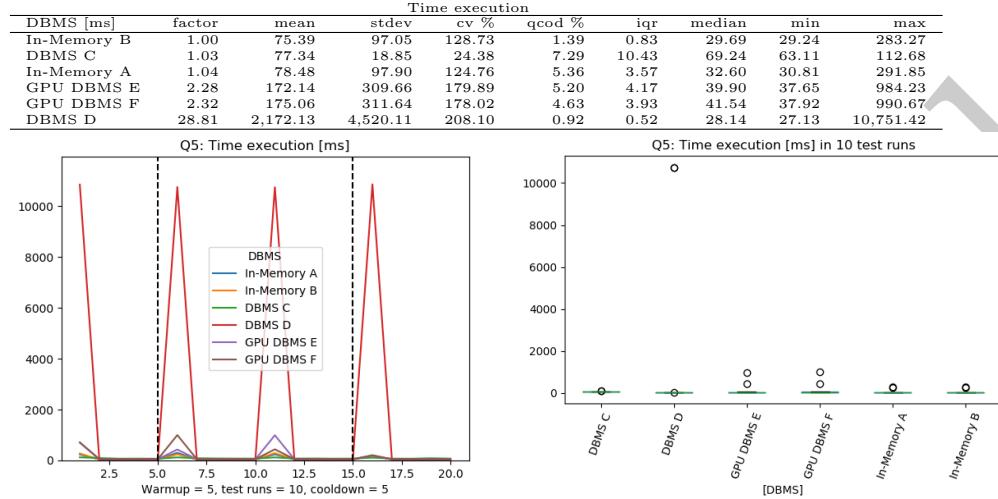


Figure 23: Query 5: Time execution

### 3.7.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	0.46	0.75	161.83	18.70	0.05	0.11	0.08	2.02
In-Memory A	1.14	0.53	0.87	165.76	18.54	0.04	0.12	0.09	2.19
In-Memory B	1.39	0.64	1.08	167.38	21.84	0.06	0.14	0.09	2.78
DBMS C	1.40	0.65	1.13	175.18	22.17	0.06	0.11	0.09	2.86
GPU DBMS E	1.41	0.65	1.22	187.26	25.71	0.05	0.09	0.07	3.51
GPU DBMS F	1.76	0.81	1.47	181.39	16.04	0.04	0.12	0.07	3.70

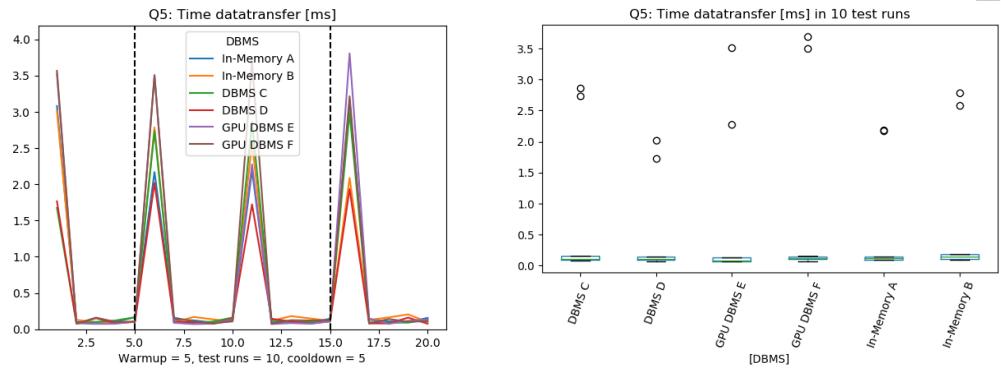


Figure 24: Query 5: Time datatransfer

### 3.7.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	501.68	9.74	1.94	1.84	18.48	501.68	492.43	510.92
DBMS C	1.28	640.86	3.69	0.58	0.55	7.00	640.86	637.36	644.36
GPU DBMS E	1.69	849.25	284.53	33.50	31.78	539.85	849.25	579.32	1,119.17
In-Memory B	1.96	981.28	31.15	3.17	3.01	59.11	981.28	951.72	1,010.83
GPU DBMS F	1.96	985.43	266.38	27.03	25.65	505.43	985.43	732.71	1,238.14
In-Memory A	2.12	1,062.52	56.74	5.34	5.07	107.66	1,062.52	1,008.69	1,116.35

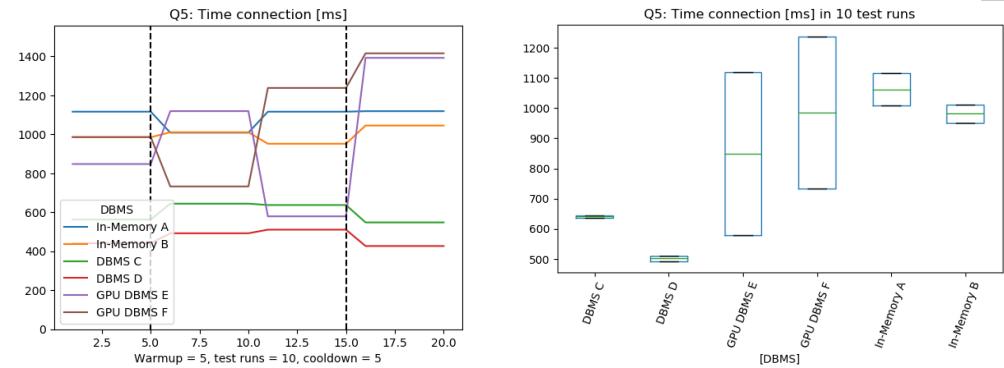


Figure 25: Query 5: Time connection

### 3.8 Query 6: Count rows in supplier

Total Times:

- In-Memory A: 2,370.89ms = 00:00:03
- In-Memory B: 2,251.93ms = 00:00:03
- DBMS C: 1,854.66ms = 00:00:02
- DBMS D: 1,542.49ms = 00:00:02
- GPU DBMS E: 2,661.78ms = 00:00:03
- GPU DBMS F: 3,481.63ms = 00:00:04

```
SELECT COUNT(*) c FROM supplier
```

Results

### 3.8.1 Hardware Metrics

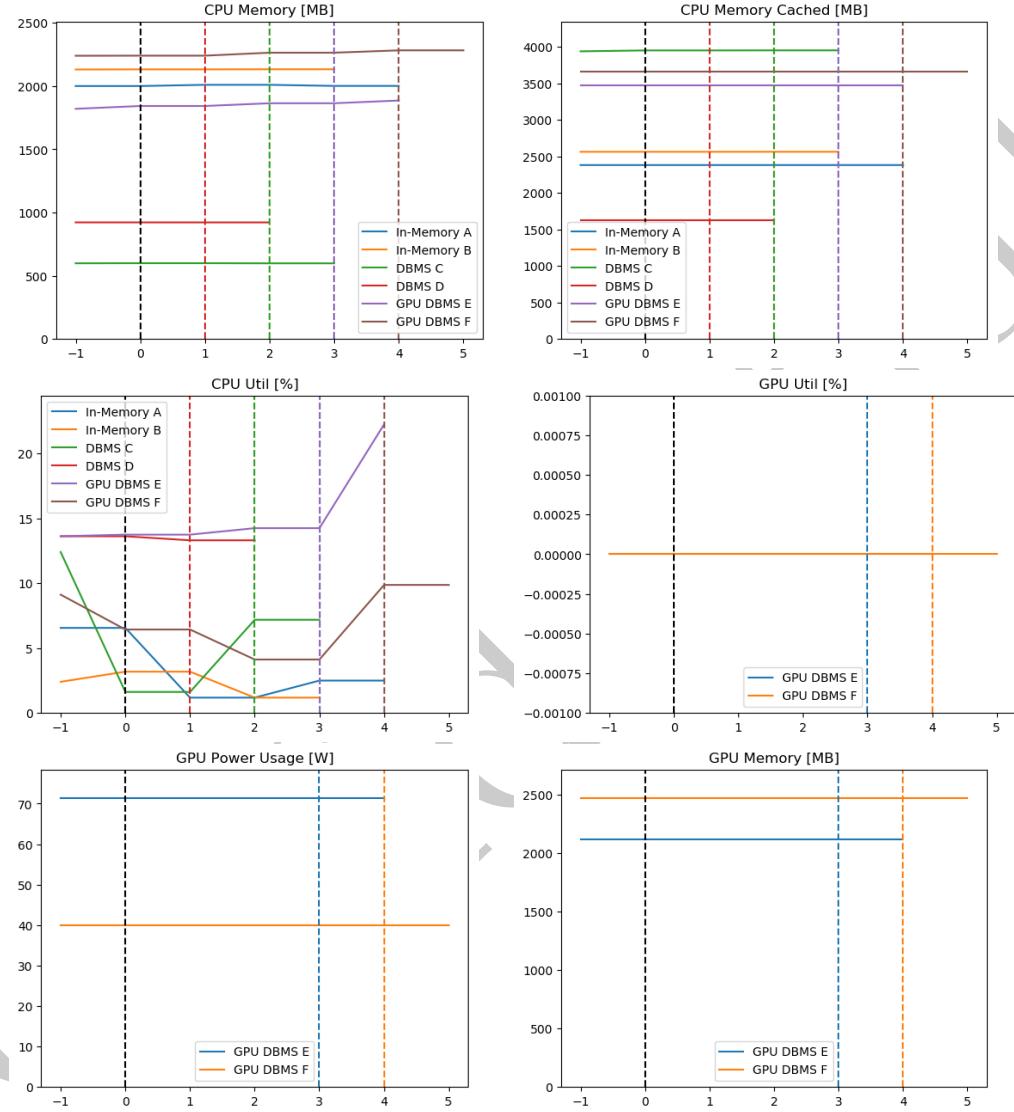


Figure 26: Query 6: Server Hardware Metrics

### 3.8.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS C	1.00	35.88	12.72	35.46	1.34	0.81	29.98	28.96	62.85
DBMS D	1.02	36.64	16.21	44.25	2.93	1.72	29.15	28.10	68.80
In-Memory B	1.69	60.75	65.84	108.38	3.96	2.43	30.79	29.09	212.85
In-Memory A	1.76	63.02	80.26	127.35	4.51	2.99	32.98	29.58	286.48
GPU DBMS F	2.69	96.48	127.96	132.62	3.56	2.99	41.01	39.23	429.70
GPU DBMS E	4.80	172.10	310.50	180.42	5.32	4.34	40.64	36.49	990.91

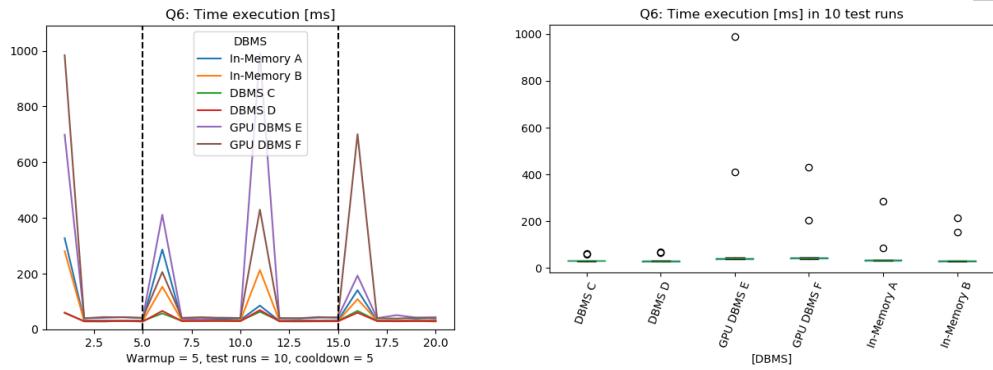


Figure 27: Query 6: Time execution

### 3.8.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS C	1.00	0.39	0.57	145.24	20.60	0.05	0.13	0.10	1.48
In-Memory B	1.49	0.58	1.02	173.91	26.42	0.07	0.10	0.09	2.92
In-Memory A	1.51	0.59	1.07	180.98	11.57	0.02	0.09	0.09	3.08
DBMS D	1.55	0.61	1.06	175.08	20.21	0.04	0.11	0.08	2.64
GPU DBMS E	1.93	0.76	1.38	182.64	6.79	0.02	0.12	0.08	3.89
GPU DBMS F	2.00	0.78	1.45	184.74	26.43	0.06	0.10	0.07	3.56

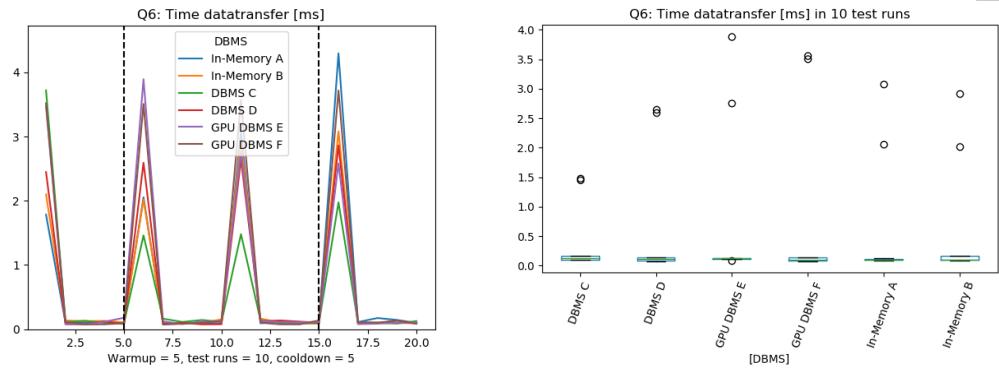


Figure 28: Query 6: Time datatransfer

### 3.8.4 Time connection

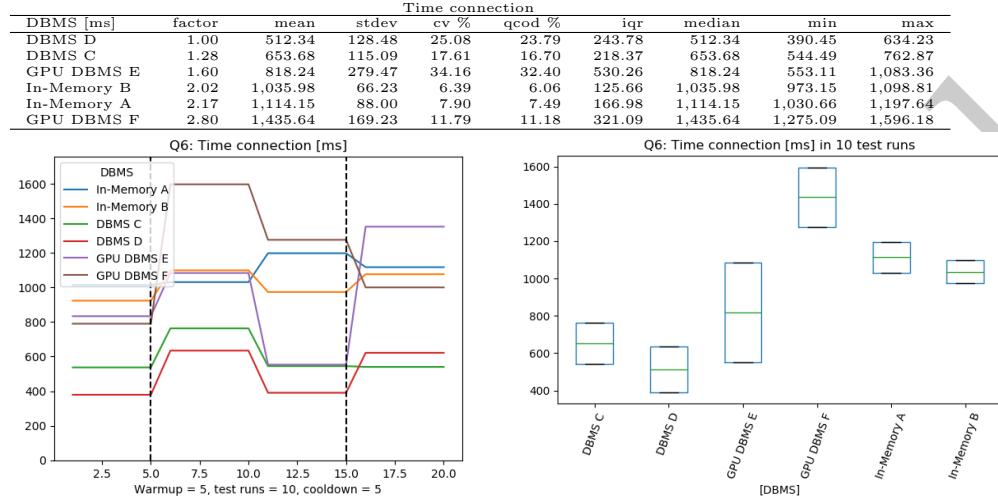


Figure 29: Query 6: Time connection

### 3.9 Query 7: Count rows in part

Total Times:

- In-Memory A: 2,582.41ms = 00:00:03
- In-Memory B: 2,373.54ms = 00:00:03
- DBMS C: 1,947.10ms = 00:00:02
- DBMS D: 3,164.55ms = 00:00:04
- GPU DBMS E: 2,865.21ms = 00:00:03
- GPU DBMS F: 3,479.52ms = 00:00:04

```
SELECT COUNT(*) c FROM part
```

Results

### 3.9.1 Hardware Metrics

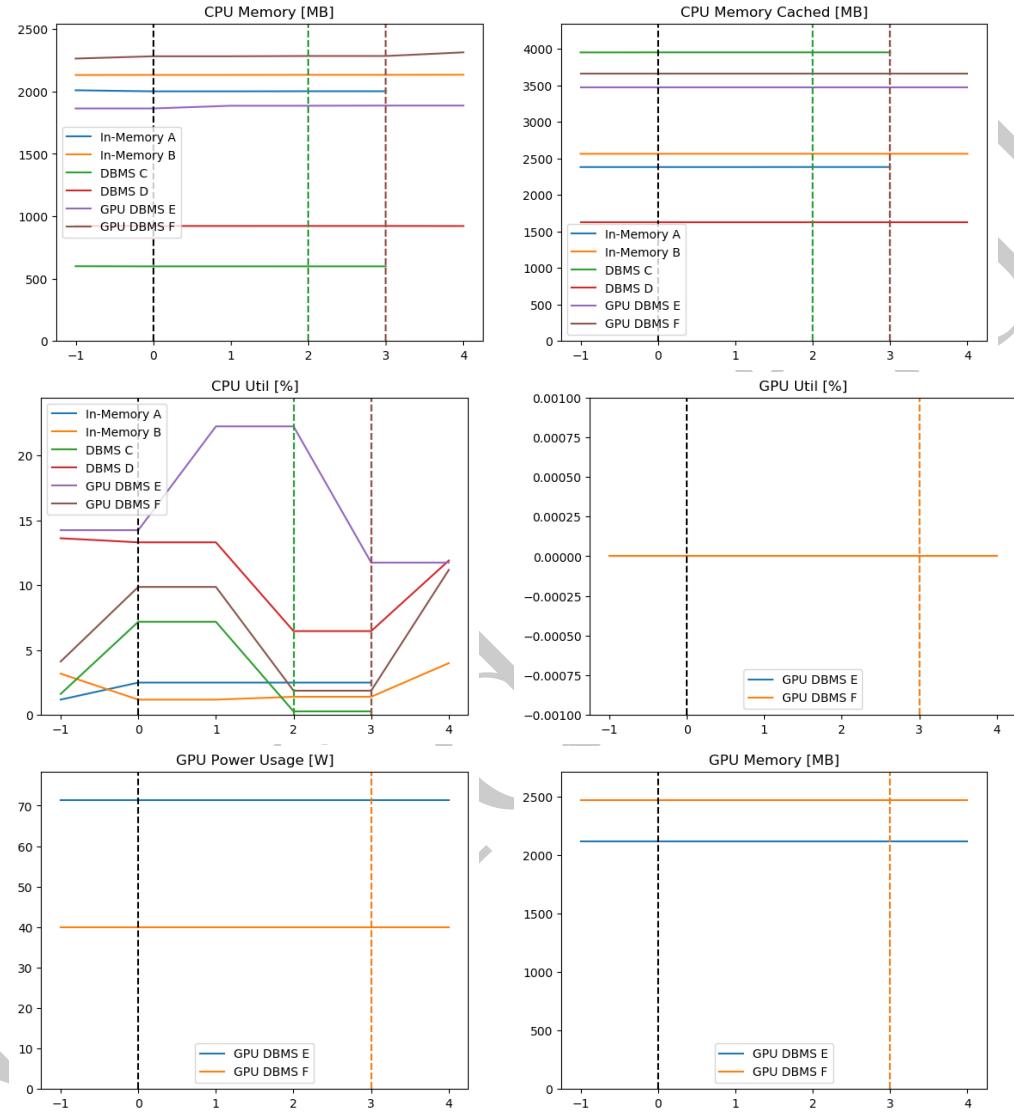


Figure 30: Query 7: Server Hardware Metrics

### 3.9.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS C	1.00	59.18	51.87	87.64	2.56	2.04	38.98	38.69	203.44
In-Memory A	1.40	82.96	80.31	96.81	12.69	12.31	48.69	37.33	269.99
In-Memory B	1.58	93.50	110.19	117.85	11.10	9.64	40.96	37.94	306.31
GPU DBMS E	2.48	146.48	232.63	158.82	8.29	7.21	41.50	37.25	715.16
GPU DBMS F	2.53	149.48	293.59	196.41	5.46	4.49	41.36	38.13	973.07
DBMS D	5.69	336.85	650.32	193.06	2.07	1.21	28.93	28.26	1,648.24

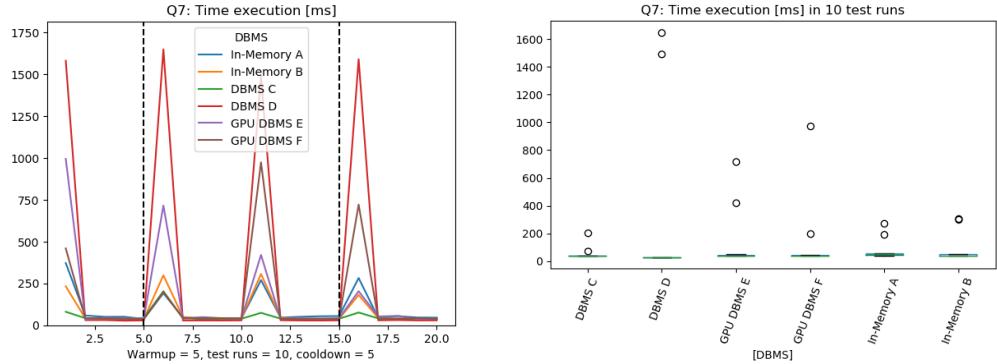


Figure 31: Query 7: Time execution

### 3.9.3 Time datatransfer

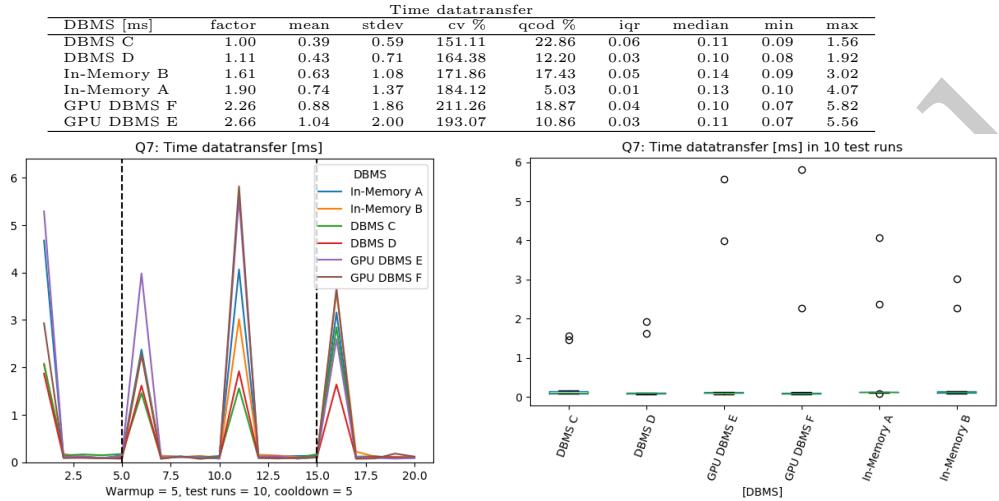


Figure 32: Query 7: Time datatransfer

### 3.9.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	499.50	52.51	10.51	9.97	99.62	499.50	449.69	549.31
DBMS C	1.34	670.33	6.11	0.91	0.86	11.58	670.33	664.54	676.13
In-Memory B	1.92	961.45	12.06	1.25	1.19	22.89	961.45	950.00	972.89
GPU DBMS E	2.03	1,014.22	147.33	14.53	13.78	279.54	1,014.22	874.45	1,153.99
GPU DBMS F	2.09	1,045.68	361.50	34.57	32.80	685.91	1,045.68	702.72	1,388.63
In-Memory A	2.26	1,126.94	48.73	4.32	4.10	92.46	1,126.94	1,080.70	1,173.17

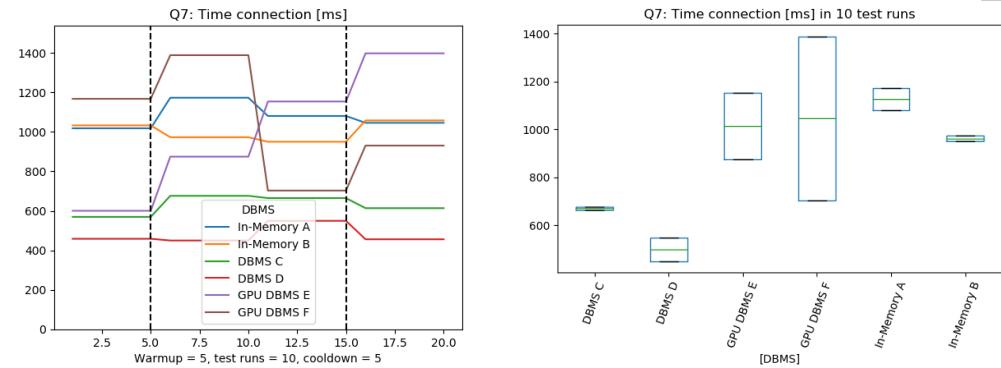


Figure 33: Query 7: Time connection

### 3.10 Query 8: Count rows in region

Total Times:

- In-Memory A: 2,252.78ms = 00:00:03
- In-Memory B: 2,359.40ms = 00:00:03
- DBMS C: 1,843.37ms = 00:00:02
- DBMS D: 1,654.98ms = 00:00:02
- GPU DBMS E: 2,864.54ms = 00:00:03
- GPU DBMS F: 3,588.45ms = 00:00:04

```
SELECT COUNT(*) c FROM region
```

Results

### 3.10.1 Hardware Metrics

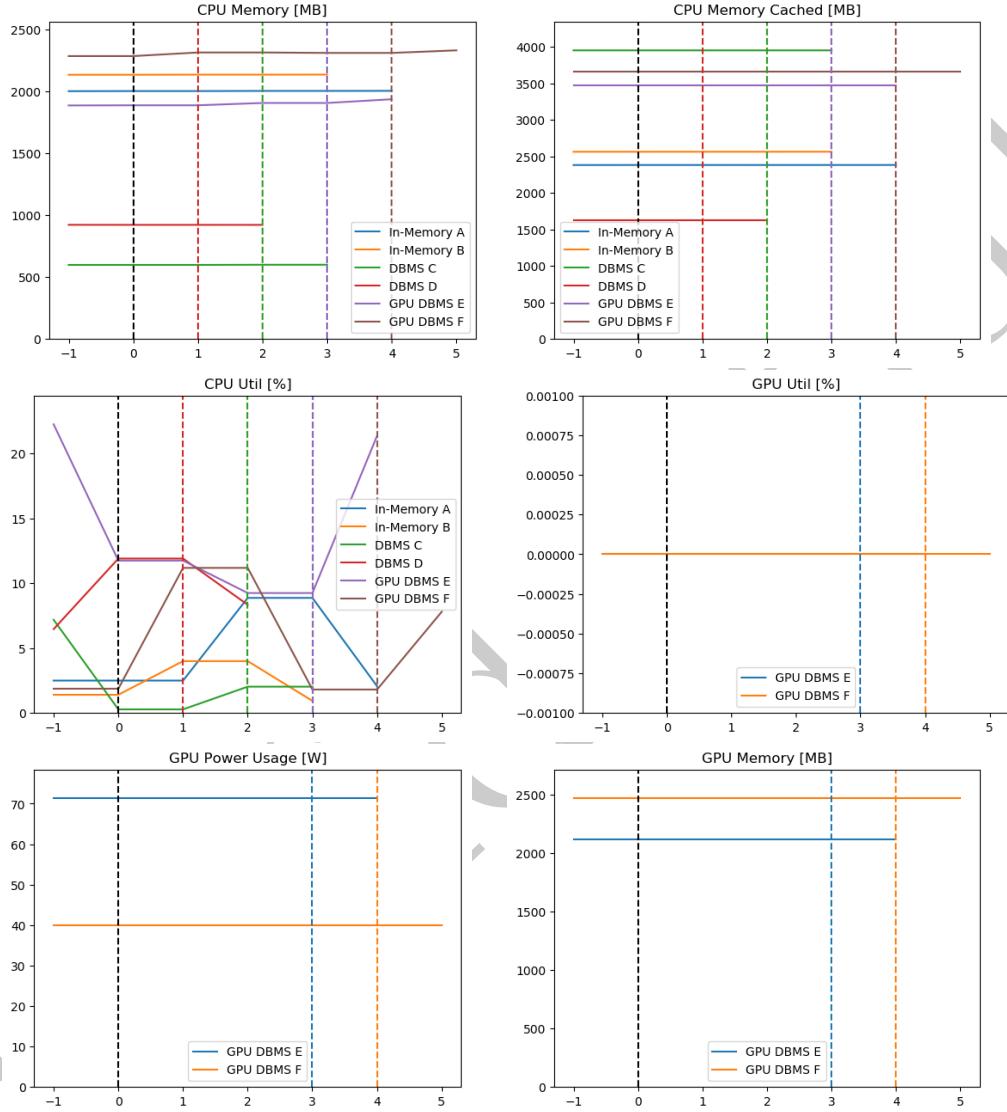


Figure 34: Query 8: Server Hardware Metrics

### 3.10.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	36.65	15.87	43.32	4.46	2.64	29.38	28.17	67.68
DBMS C	1.35	49.51	51.33	103.68	2.11	1.27	30.24	29.06	192.54
In-Memory A	1.47	53.76	55.19	102.65	1.18	0.68	28.76	28.03	185.18
In-Memory B	1.90	69.74	95.57	137.03	3.93	2.36	30.00	28.52	324.70
GPU DBMS E	3.29	120.43	210.34	174.66	11.67	9.78	37.66	35.63	703.25
GPU DBMS F	3.36	123.04	211.97	172.28	4.00	3.24	40.20	37.39	708.29

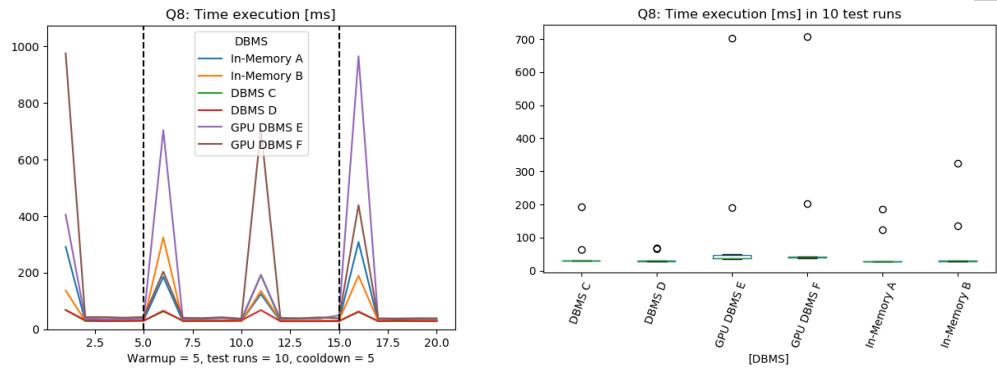


Figure 35: Query 8: Time execution

### 3.10.3 Time datatransfer

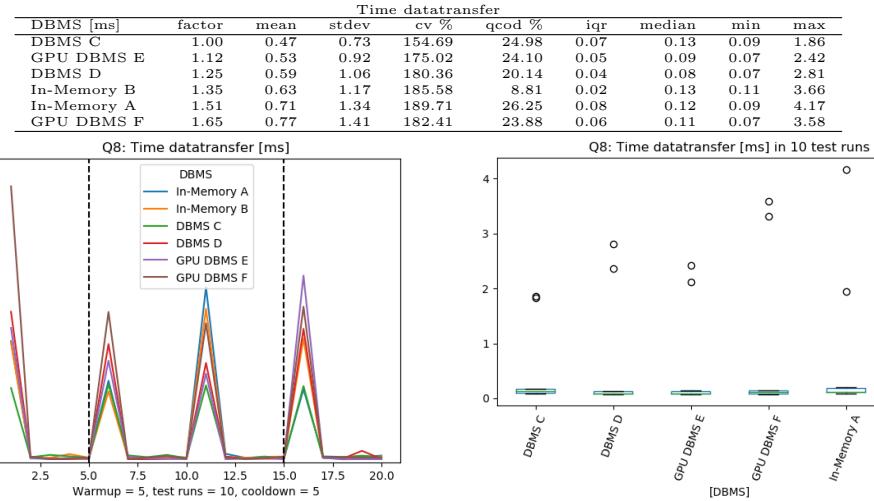


Figure 36: Query 8: Time datatransfer

### 3.10.4 Time connection

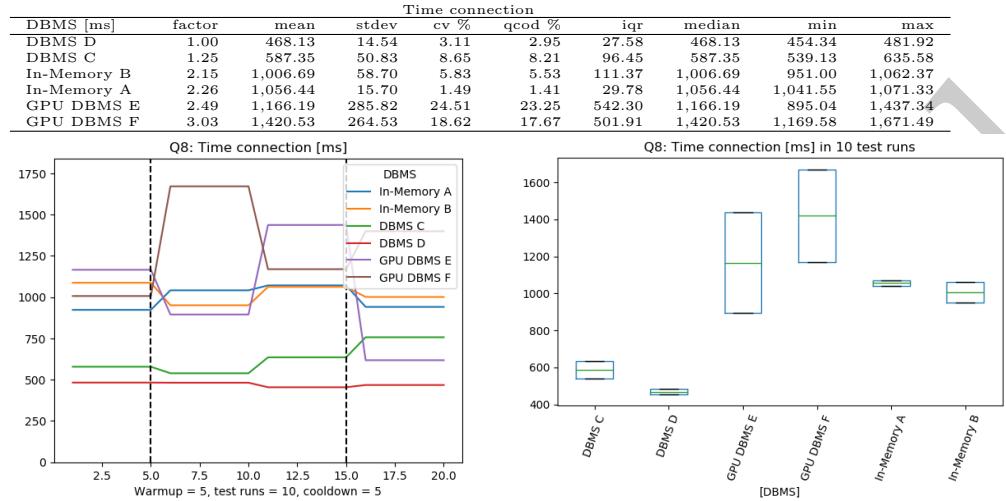


Figure 37: Query 8: Time connection

### 3.11 Query 9: Pricing Summary Report (TPC-H Q1)

Total Times:

- In-Memory A: 4,223.38ms = 00:00:05
- In-Memory B: 3,573.94ms = 00:00:04
- DBMS C: 32,873.39ms = 00:00:33
- DBMS D: 120,463.73ms = 00:02:01
- GPU DBMS E: 4,772.12ms = 00:00:05
- GPU DBMS F: 12,738.45ms = 00:00:13

```
select
    l_returnflag ,
    l_linenumber ,
    cast(sum(l_quantity) as int) as sum_qty,
    sum(l_extendedprice) as sum_base_price,
    sum(l_extendedprice*(1-l_discount)) as sum_disc_price,
    sum(l_extendedprice*(1-l_discount)*(1+l_tax)) as sum_charge,
    avg(l_quantity) as avg_qty,
    avg(l_extendedprice) as avg_price,
    avg(l_discount) as avg_disc,
    count(*) as count_order
from
    lineitem
where
    l_shipdate <= date '1998-12-01' - interval '{DELTA}' day
group by
    l_returnflag ,
    l_linenumber
order by
    l_returnflag ,
    l_linenumber
limit 10000000
```

Results

### 3.11.1 Hardware Metrics

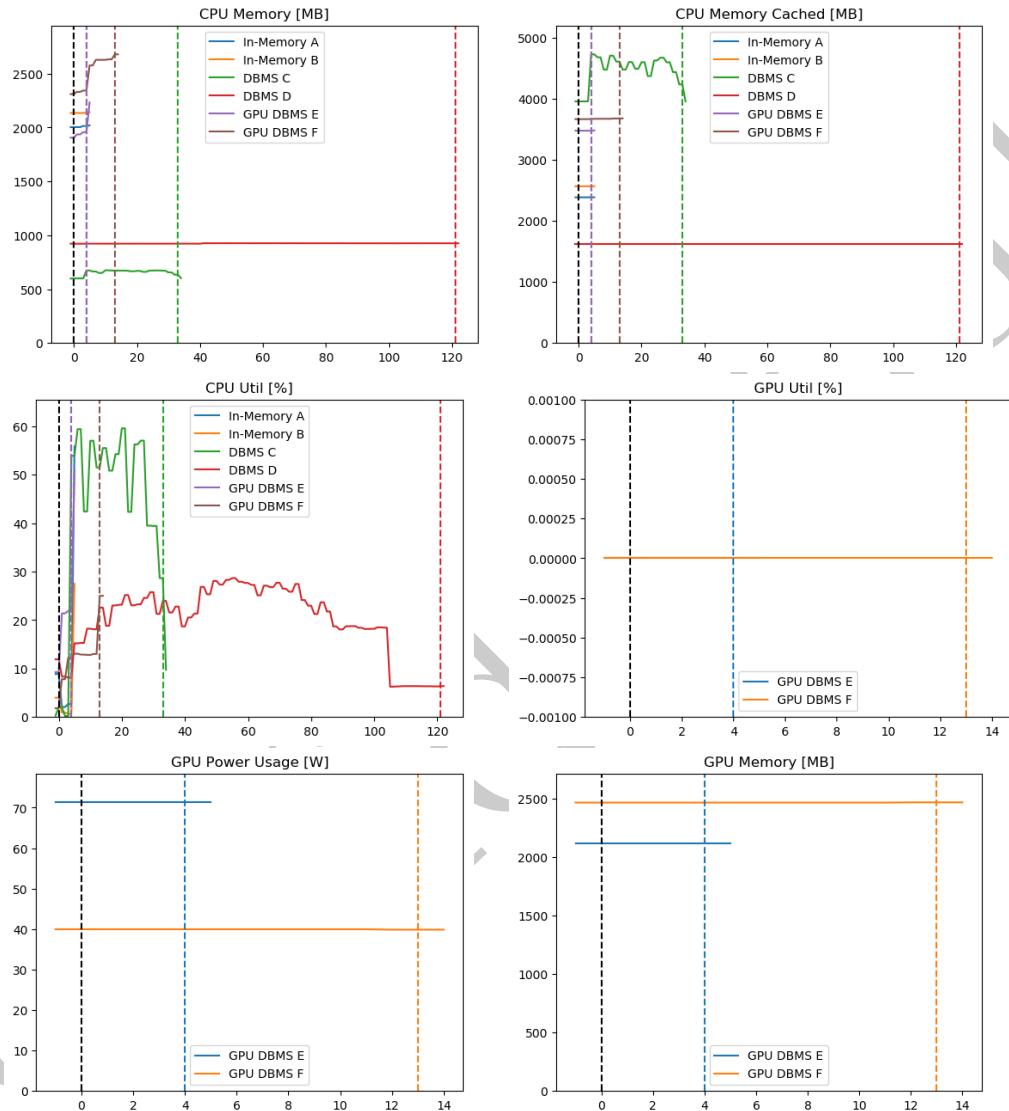


Figure 38: Query 9: Server Hardware Metrics

### 3.11.2 Time execution

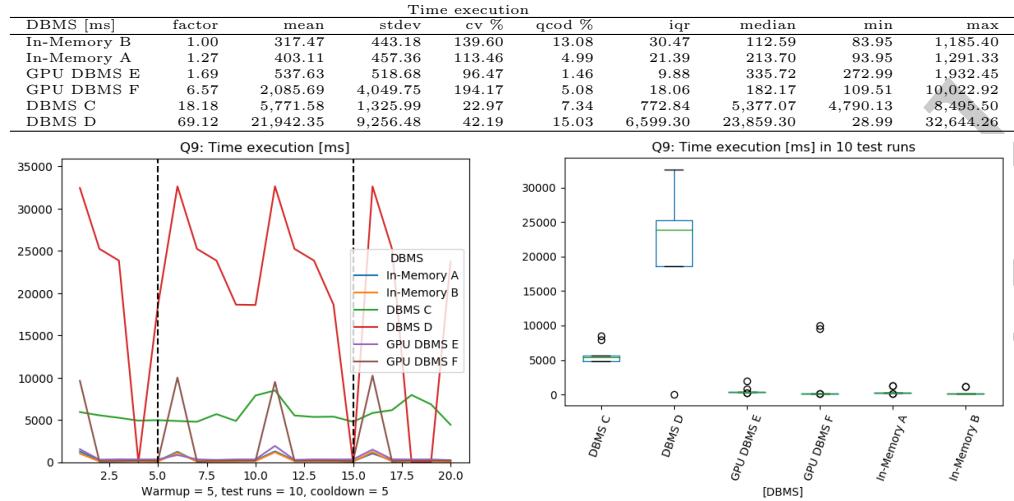


Figure 39: Query 9: Time execution

### 3.11.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS F	1.00	1.62	1.38	85.71	5.73	0.11	0.96	0.92	4.63
GPU DBMS E	1.20	1.94	1.77	91.20	25.21	0.66	1.06	0.90	6.11
DBMS D	1.57	2.53	1.76	69.40	13.31	0.48	1.77	1.46	6.10
DBMS C	1.80	2.90	2.42	83.39	3.11	0.11	1.79	1.62	8.32
In-Memory A	1.88	3.04	2.38	78.37	20.36	0.88	1.83	1.53	8.09
In-Memory B	2.17	3.51	3.84	109.24	18.69	0.73	1.67	1.54	12.26

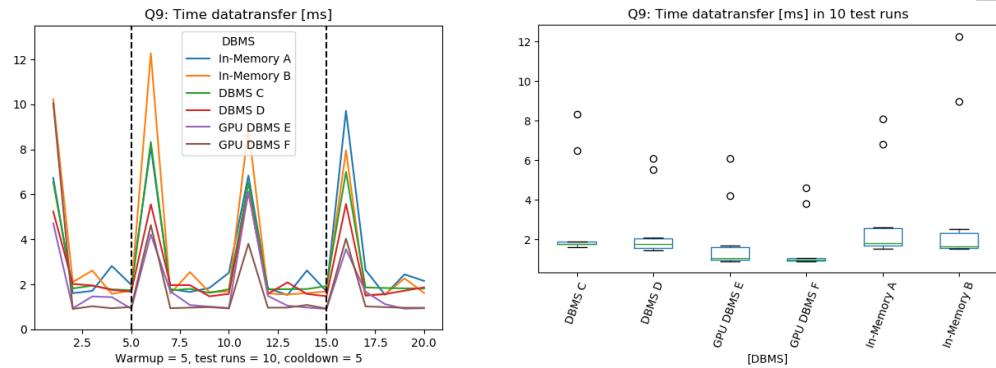


Figure 40: Query 9: Time datatransfer

### 3.11.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	441.36	3.20	0.73	0.69	6.08	441.36	438.32	444.40
DBMS C	1.44	637.16	74.56	11.70	11.10	141.47	637.16	566.42	707.89
GPU DBMS E	2.12	936.46	408.99	43.67	41.43	776.00	936.46	548.46	1,324.46
In-Memory B	2.25	992.00	21.50	2.17	2.06	40.79	992.00	971.60	1,012.40
In-Memory A	2.34	1,031.74	3.53	0.34	0.32	6.70	1,031.74	1,028.39	1,035.08
GPU DBMS F	2.45	1,083.19	262.23	24.21	22.97	497.55	1,083.19	834.41	1,331.96

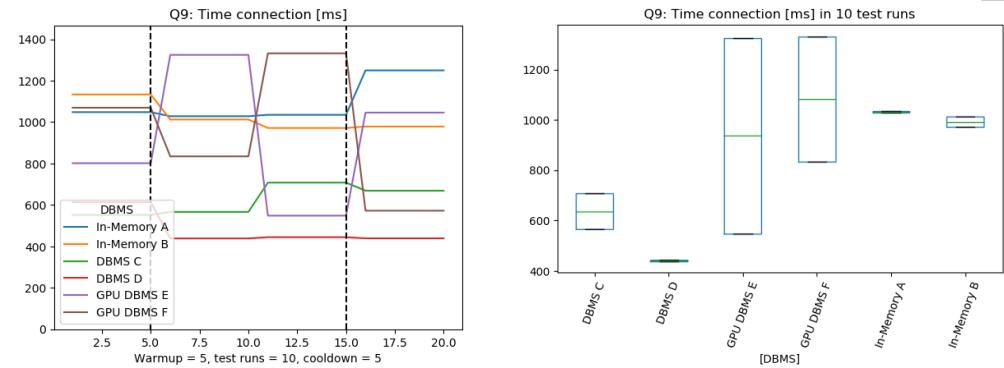


Figure 41: Query 9: Time connection

### 3.12 Query 11: Shipping Priority (TPC-H Q3)

Total Times:

- In-Memory A: 19,520.05ms = 00:00:20
- In-Memory B: 17,517.86ms = 00:00:18
- DBMS C: 15,064.21ms = 00:00:16
- DBMS D: 125,549.94ms = 00:02:06
- GPU DBMS E: 14,748.26ms = 00:00:15
- GPU DBMS F: 14,656.47ms = 00:00:15

```
select
l_orderkey,
sum(l_extendedprice*(1-l_discount)) as revenue,
o_orderdate,
o_shippriority
from
customer,
orders,
lineitem
where
c_mktsegment = '{SEGMENT}'
and c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate < date '{DATE}'
and l_shipdate > date '{DATE}'
group by
l_orderkey,
o_orderdate,
o_shippriority
order by
revenue desc,
o_orderdate
limit 10000000
```

Results

### 3.12.1 Hardware Metrics

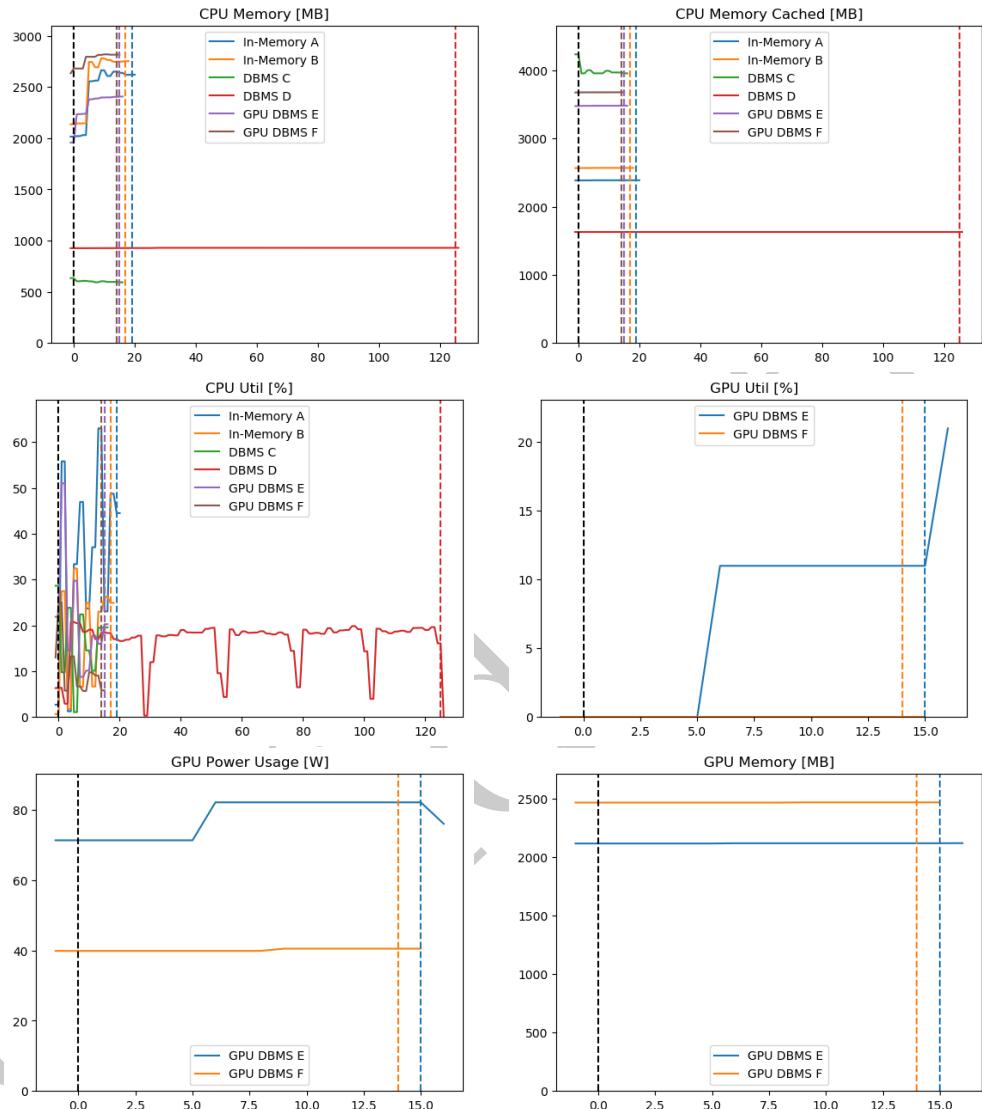


Figure 42: Query 11: Server Hardware Metrics

### 3.12.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS E	1.00	671.54	382.24	56.92	14.91	170.35	505.46	277.64	1,384.50
GPU DBMS F	1.09	733.17	497.97	67.92	14.34	155.60	531.44	343.16	1,806.08
DBMS C	1.36	910.23	142.60	15.67	5.74	100.39	862.89	796.07	1,254.19
In-Memory B	1.89	1,270.01	898.45	70.74	12.94	238.88	893.01	565.78	2,981.29
In-Memory A	2.32	1,555.34	990.79	63.70	24.33	595.88	1,270.06	654.70	3,528.69
DBMS D	34.03	22,849.66	908.13	3.97	1.09	493.85	22,378.76	22,221.24	24,548.23

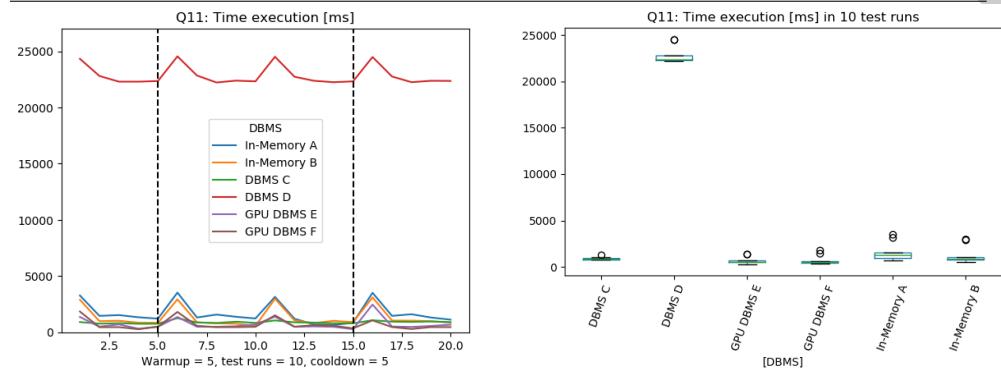


Figure 43: Query 11: Time execution

### 3.12.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
In-Memory A	1.00	1,209.11	246.58	20.39	9.27	213.86	1,115.77	974.35	1,674.03
In-Memory B	1.02	1,231.36	306.71	24.91	7.31	166.02	1,090.57	964.71	1,845.86
GPU DBMS E	1.02	1,235.62	246.05	19.91	16.83	419.40	1,130.40	950.35	1,635.96
GPU DBMS F	1.03	1,244.26	272.49	21.90	18.92	479.34	1,070.35	1,002.78	1,668.89
DBMS C	1.11	1,346.56	311.22	23.11	19.69	544.44	1,237.78	995.78	1,759.40
DBMS D	1.15	1,384.61	235.74	17.03	10.34	283.47	1,327.74	1,070.22	1,756.33

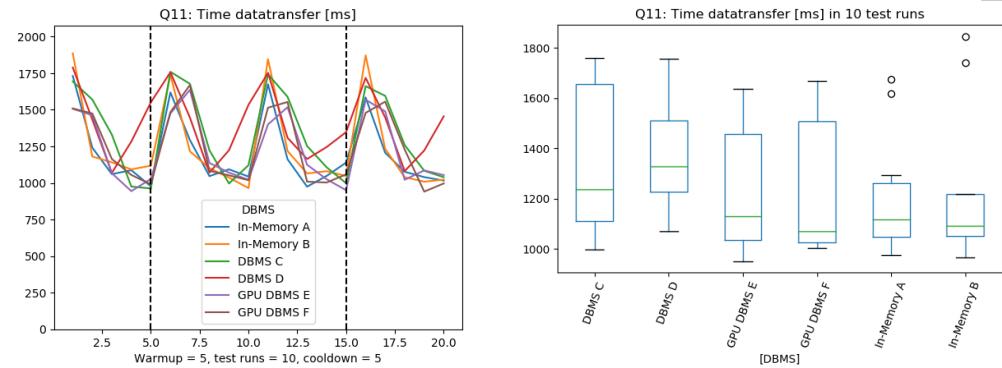


Figure 44: Query 11: Time datatransfer

### 3.12.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	393.31	5.80	1.47	1.40	11.00	393.31	387.80	398.81
DBMS C	1.65	648.69	7.44	1.15	1.09	14.12	648.69	641.63	655.75
GPU DBMS E	2.38	934.75	145.96	15.62	14.81	276.94	934.75	796.28	1,073.23
In-Memory B	2.53	996.27	1.95	0.20	0.19	3.69	996.27	994.42	998.11
In-Memory A	2.69	1,057.38	65.25	6.17	5.85	123.80	1,057.38	995.48	1,119.29
GPU DBMS F	2.78	1,094.34	282.28	25.79	24.47	535.58	1,094.34	826.55	1,362.14

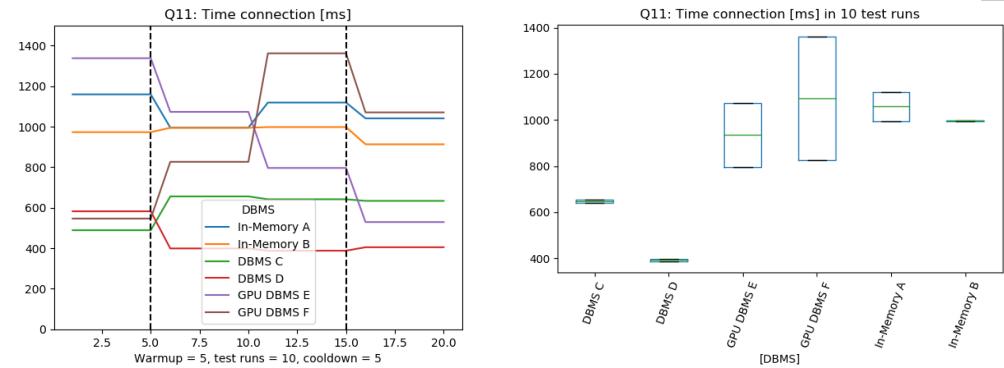


Figure 45: Query 11: Time connection

### 3.13 Query 13: Local Supplier Volume (TPC-H Q5)

Total Times:

- In-Memory A: 5,195.33ms = 00:00:06
- In-Memory B: 4,678.28ms = 00:00:05
- DBMS C: 5,385.04ms = 00:00:06
- DBMS D: 115,130.83ms = 00:01:56
- GPU DBMS E: 3,163.24ms = 00:00:04
- GPU DBMS F: 3,157.69ms = 00:00:04

```
select
    n_name,
    sum(l_extendedprice * (1 - l_discount)) as revenue
from
    customer,
    orders,
    lineitem,
    supplier,
    nation,
    region
where
    c_custkey = o_custkey
    and l_orderkey = o_orderkey
    and l_suppkey = s_suppkey
    and c_nationkey = s_nationkey
    and s_nationkey = n_nationkey
    and n_regionkey = r_regionkey
    and r_name = '{REGION}'
    and o_orderdate >= date '{DATE}'
    and o_orderdate < date '{DATE}' + interval '1' year
group by
    n_name
order by
    revenue desc
limit 10000000
```

Results

### 3.13.1 Hardware Metrics

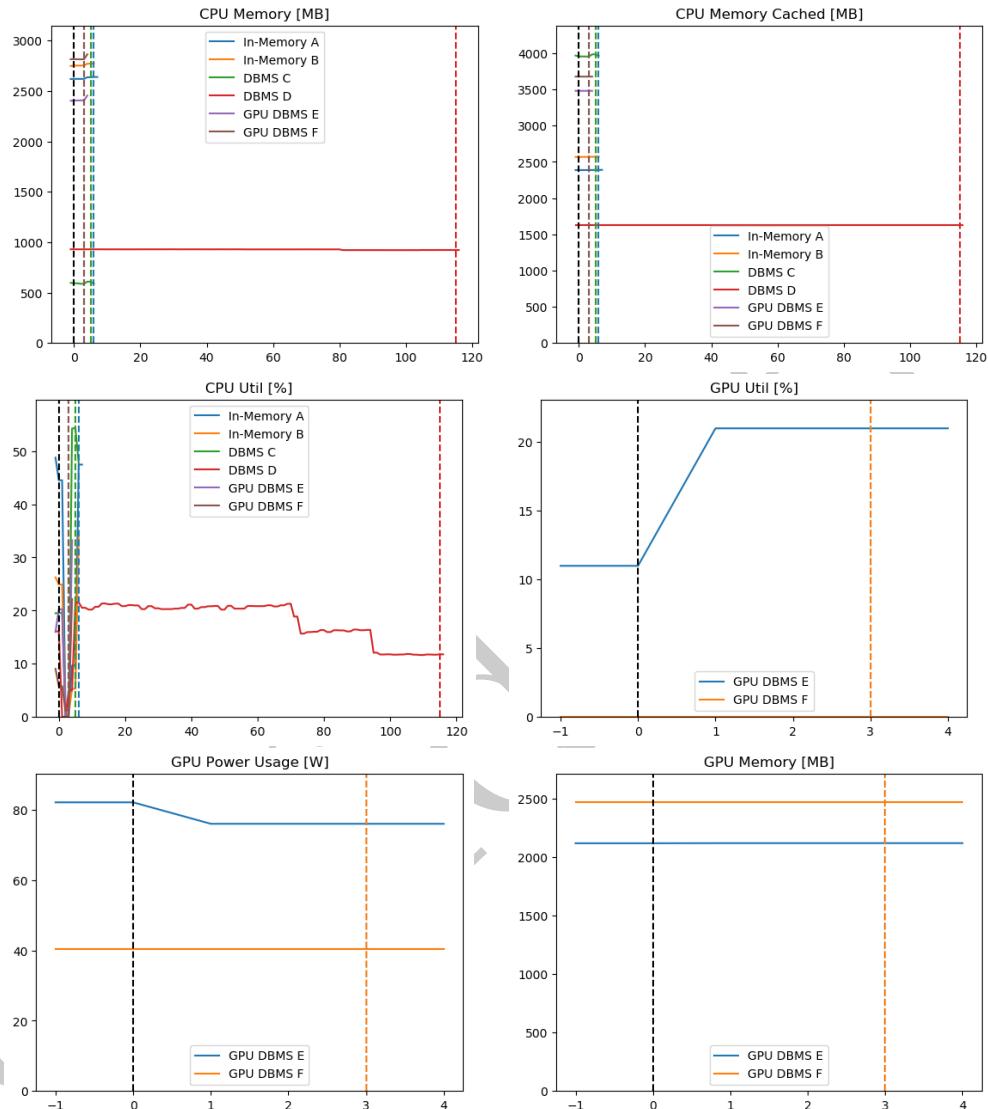


Figure 46: Query 13: Server Hardware Metrics

### 3.13.2 Time execution

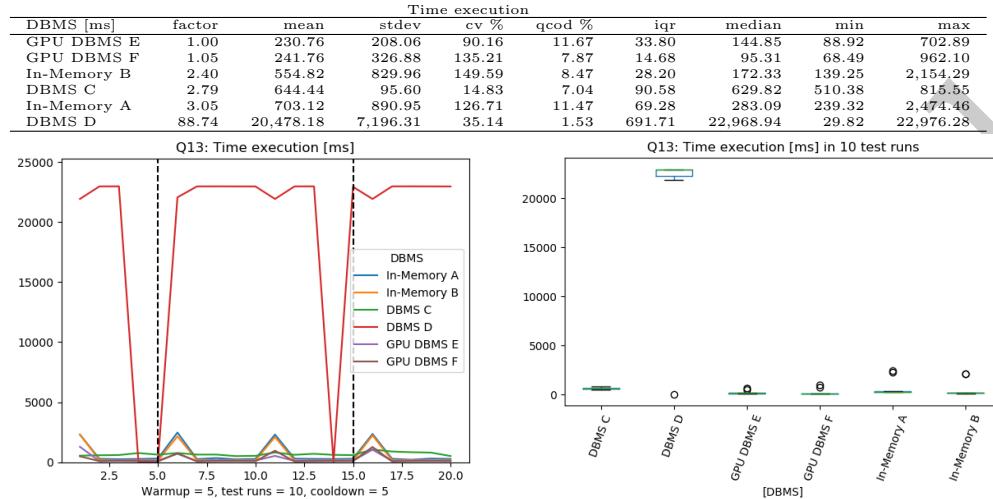


Figure 47: Query 13: Time execution

### 3.13.3 Time datatransfer

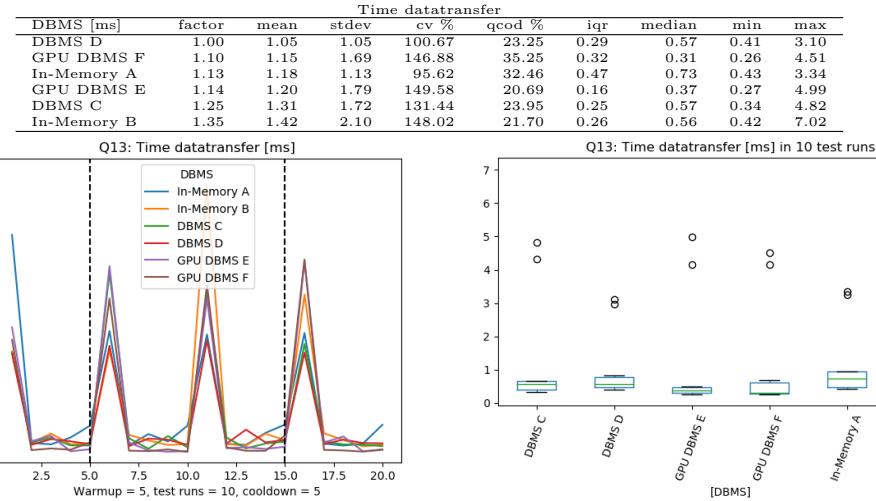


Figure 48: Query 13: Time datatransfer

### 3.13.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	447.53	52.85	11.81	11.20	100.27	447.53	397.40	497.67
DBMS C	1.09	488.90	1.31	0.27	0.25	2.48	488.90	487.66	490.14
In-Memory A	2.03	908.01	83.79	9.23	8.75	158.98	908.01	828.52	987.50
GPU DBMS F	2.11	944.52	140.99	14.93	14.16	267.51	944.52	810.76	1,078.27
In-Memory B	2.18	975.29	4.48	0.46	0.44	8.50	975.29	971.04	979.54
GPU DBMS E	2.65	1,185.47	145.26	12.25	11.62	275.61	1,185.47	1,047.66	1,323.27

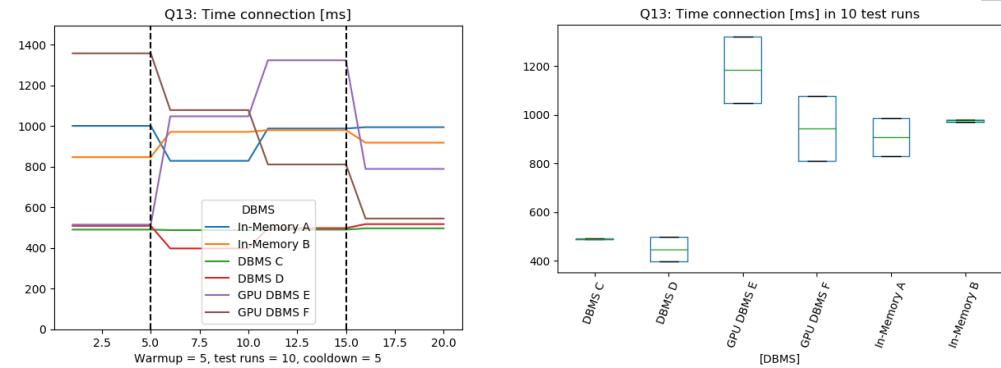


Figure 49: Query 13: Time connection

### 3.14 Query 14: Forecasting Revenue Change (TPC-H Q6)

Total Times:

- In-Memory A: 2,572.98ms = 00:00:03
- In-Memory B: 2,575.61ms = 00:00:03
- DBMS C: 4,179.43ms = 00:00:05
- DBMS D: 93,267.02ms = 00:01:34
- GPU DBMS E: 3,063.16ms = 00:00:04
- GPU DBMS F: 3,079.31ms = 00:00:04

```
select
sum(l_extendedprice*l_discount) as revenue
from
lineitem
where
l_shipdate >= date '{DATE}'
and l_shipdate < date '{DATE}' + interval '1' year
and l_discount between {DISCOUNT} - 0.01 and {DISCOUNT} + 0.01
and l_quantity < {QUANTITY}
limit 10000000
```

Results

### 3.14.1 Hardware Metrics

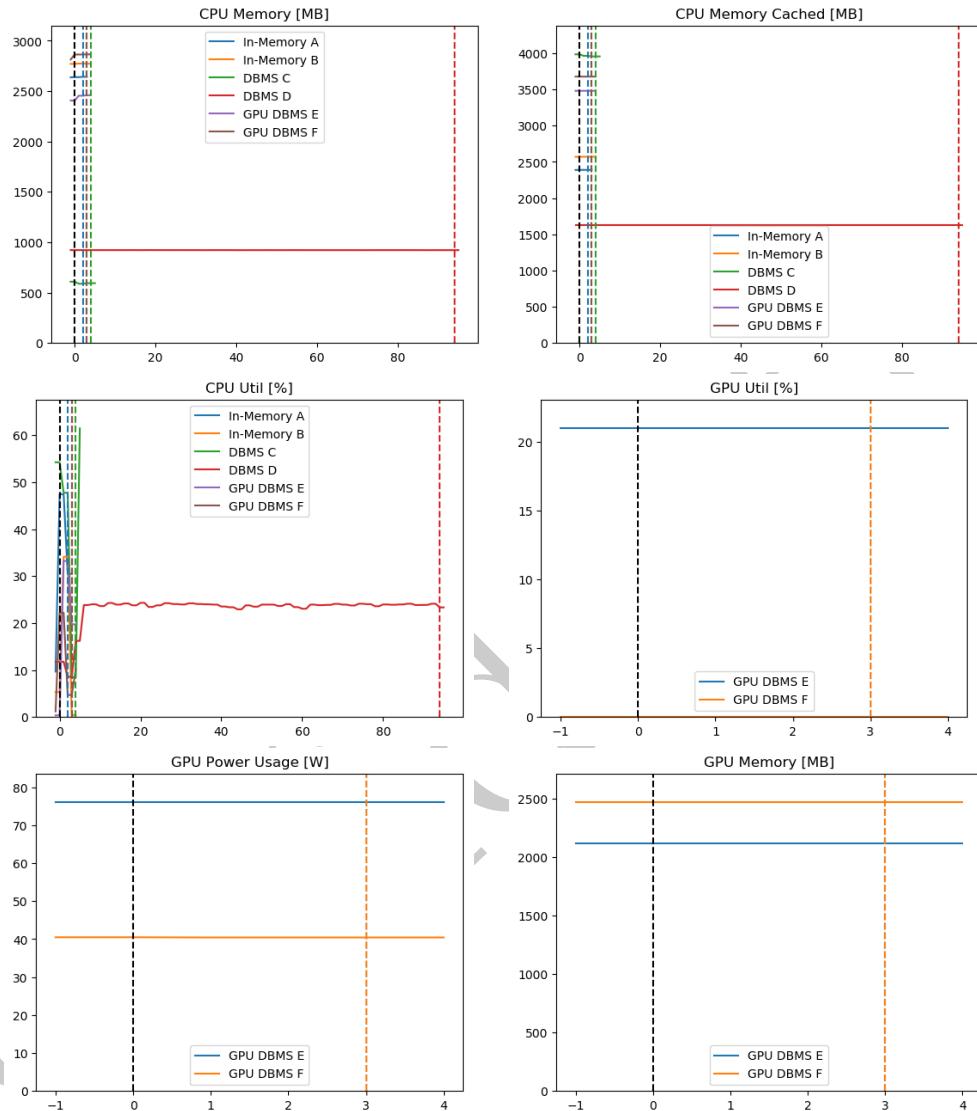


Figure 50: Query 14: Server Hardware Metrics

### 3.14.2 Time execution

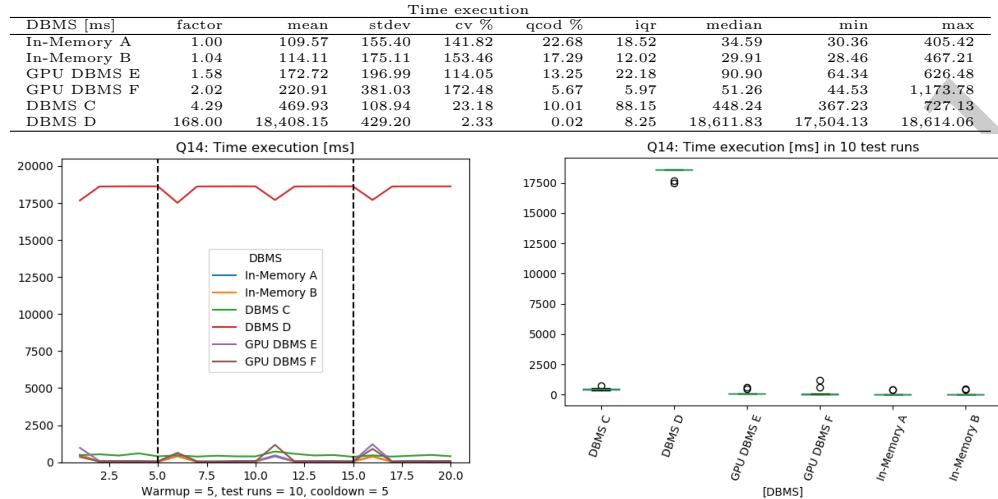


Figure 51: Query 14: Time execution

### 3.14.3 Time datatransfer

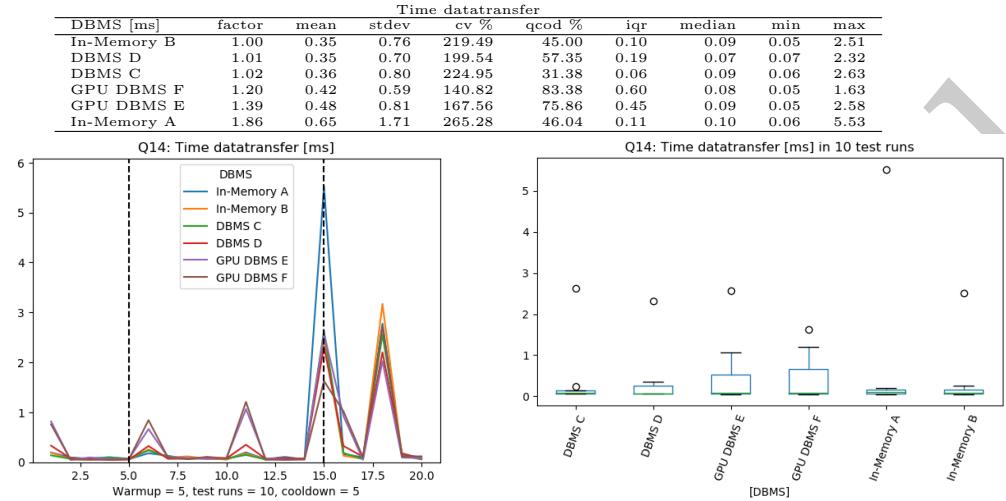


Figure 52: Query 14: Time datatransfer

### 3.14.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	472.66	96.32	20.38	19.33	182.76	472.66	381.27	564.04
DBMS C	1.22	575.04	57.96	10.08	9.56	109.98	575.04	520.05	630.02
GPU DBMS F	1.88	888.74	290.20	32.65	30.98	550.62	888.74	613.43	1,164.05
In-Memory B	2.13	1,008.20	7.71	0.76	0.73	14.63	1,008.20	1,000.88	1,015.52
In-Memory A	2.21	1,044.14	5.89	0.56	0.54	11.18	1,044.14	1,038.55	1,049.73
GPU DBMS E	2.62	1,236.79	150.55	12.17	11.55	285.65	1,236.79	1,093.97	1,379.61

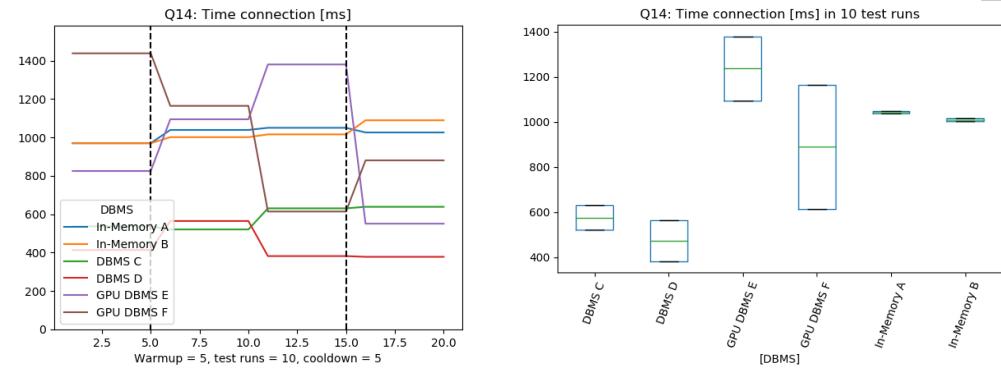


Figure 53: Query 14: Time connection

### 3.15 Query 15: Forecasting Revenue Change (TPC-H Q7)

Total Times:

- In-Memory A: 9,831.39ms = 00:00:10
- In-Memory B: 7,199.01ms = 00:00:08
- DBMS C: 5,771.19ms = 00:00:06
- DBMS D: 114,834.96ms = 00:01:55
- GPU DBMS E: 3,460.20ms = 00:00:04
- GPU DBMS F: 3,271.56ms = 00:00:04

```
select
    supp_nation,
    cust_nation,
    l_year, sum(volume) as revenue
  from (
    select
        n1.n_name as supp_nation,
        n2.n_name as cust_nation,
        cast(extract(year from l_shipdate) as int) as l_year,
        l_extendedprice * (1 - l_discount) as volume
      from
        supplier,
        lineitem,
        orders,
        customer,
        nation n1,
        nation n2
     where
       s_suppkey = l_suppkey
     and o_orderkey = l_orderkey
     and c_custkey = o_custkey
     and s_nationkey = n1.n_nationkey
     and c_nationkey = n2.n_nationkey
     and (
        (n1.n_name = '{NATION1}' and n2.n_name = '{NATION2}')
       or (n1.n_name = '{NATION2}' and n2.n_name = '{NATION1}')
     )
     and l_shipdate between date '1995-01-01' and date '1996-12-31'
   ) as shipping
  group by
    supp_nation,
    cust_nation,
    l_year
  order by
    supp_nation,
    cust_nation,
    l_year
  limit 10000000
```

Results

### 3.15.1 Hardware Metrics

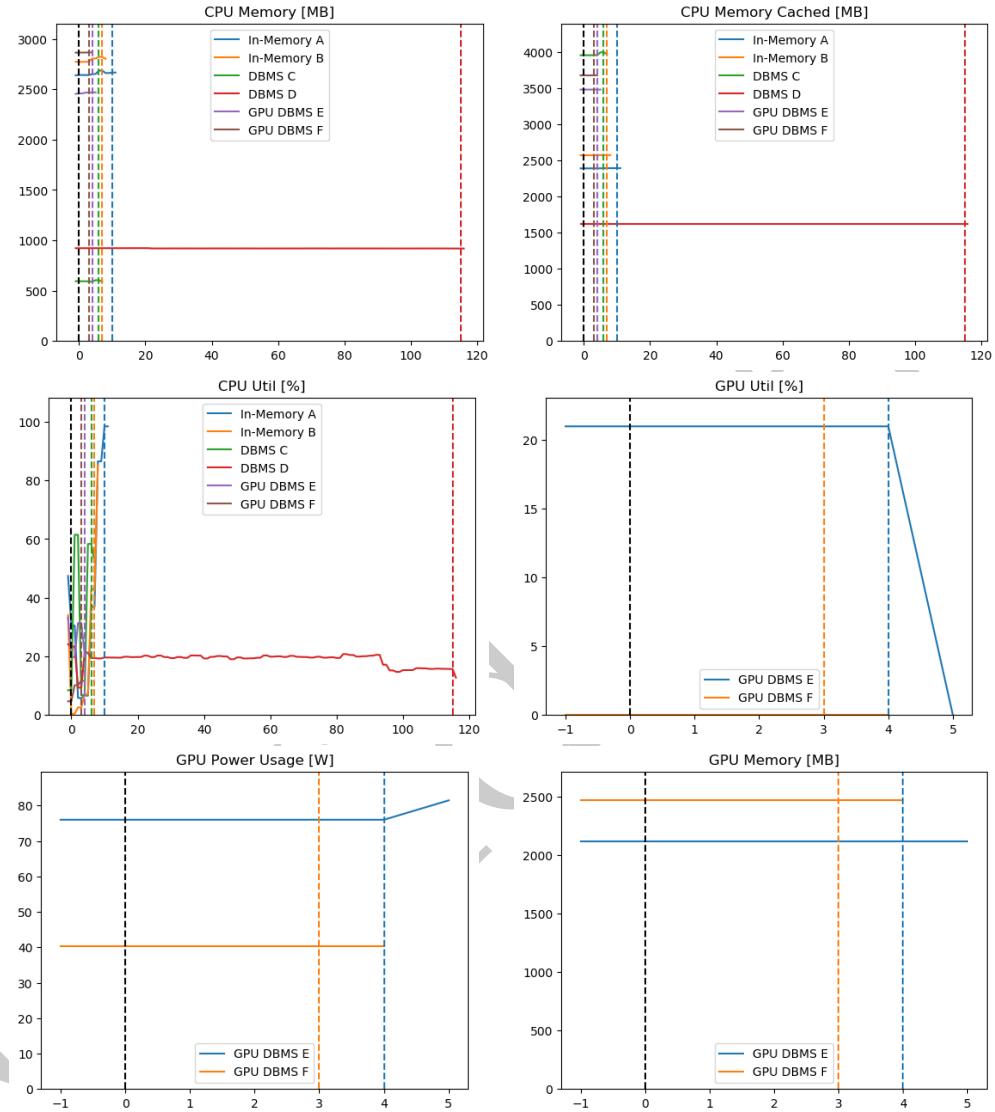


Figure 54: Query 15: Server Hardware Metrics

### 3.15.2 Time execution

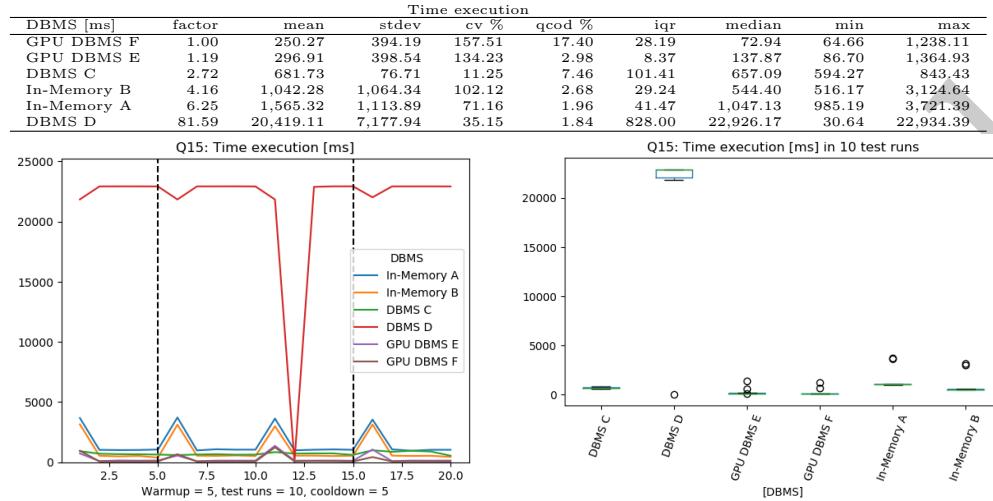


Figure 55: Query 15: Time execution

### 3.15.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS C	1.00	1.25	1.44	115.69	9.39	0.11	0.59	0.50	4.33
In-Memory B	1.07	1.34	1.53	114.10	5.30	0.07	0.63	0.55	4.38
GPU DBMS E	1.08	1.34	1.53	113.70	19.77	0.29	0.67	0.46	4.86
DBMS D	1.13	1.41	1.56	110.89	19.46	0.28	0.72	0.52	4.47
GPU DBMS F	1.44	1.79	2.55	142.52	18.19	0.25	0.76	0.37	8.00
In-Memory A	1.90	2.37	2.55	107.36	42.55	1.36	1.05	0.63	7.12

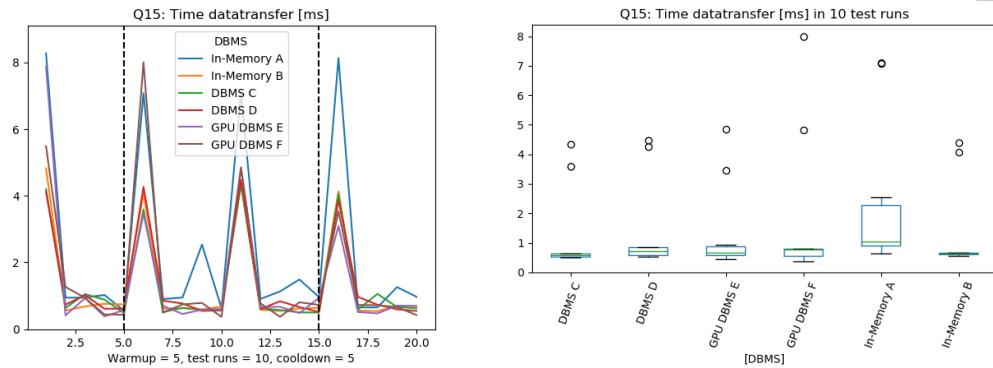


Figure 56: Query 15: Time datatransfer

### 3.15.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	514.48	1.47	0.29	0.27	2.79	514.48	513.08	515.88
DBMS C	1.09	558.92	3.78	0.68	0.64	7.17	558.92	555.34	562.51
GPU DBMS F	1.66	852.78	256.91	30.13	28.58	487.45	852.78	609.05	1,096.50
GPU DBMS E	1.91	985.10	424.53	43.10	40.88	805.49	985.10	582.35	1,387.84
In-Memory A	1.92	988.68	29.90	3.02	2.87	56.72	988.68	960.32	1,017.04
In-Memory B	2.03	1,046.05	61.59	5.89	5.59	116.86	1,046.05	987.62	1,104.47

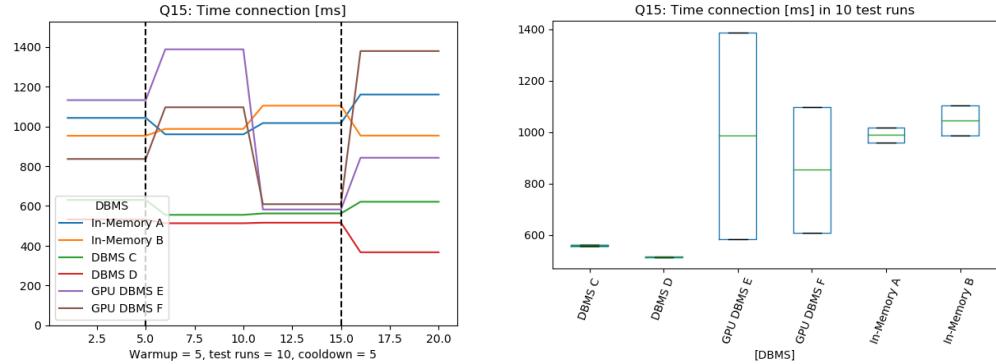


Figure 57: Query 15: Time connection

### 3.16 Query 17: Product Type Profit Measure (TPC-H Q9)

Total Times:

- In-Memory A: 22,289.67ms = 00:00:23
- In-Memory B: 14,036.48ms = 00:00:15
- DBMS C: 10,209.81ms = 00:00:11
- DBMS D: 189,152.95ms = 00:03:10
- GPU DBMS E: 8,695.10ms = 00:00:09
- GPU DBMS F: 6,994.05ms = 00:00:07

```
select
nation,
o_year,
sum(amount) as sum_profit
from (
select
n.name as nation,
cast(extract(year from o_orderdate) as int)as o_year,
l_extendedprice * (1 - l_discount) - ps_supplycost * l_quantity as amount
from
part,
supplier,
lineitem,
partsupp,
orders,
nation
where
s_suppkey = l_suppkey
and ps_suppkey = l_suppkey
and ps_partkey = l_partkey
and p_partkey = l_partkey
and o_orderkey = l_orderkey
and s_nationkey = n_nationkey
and p_name like '%{COLOR}%' )
as profit
group by
nation,
o_year
order by
nation,
o_year desc
limit 10000000
```

Results

### 3.16.1 Hardware Metrics

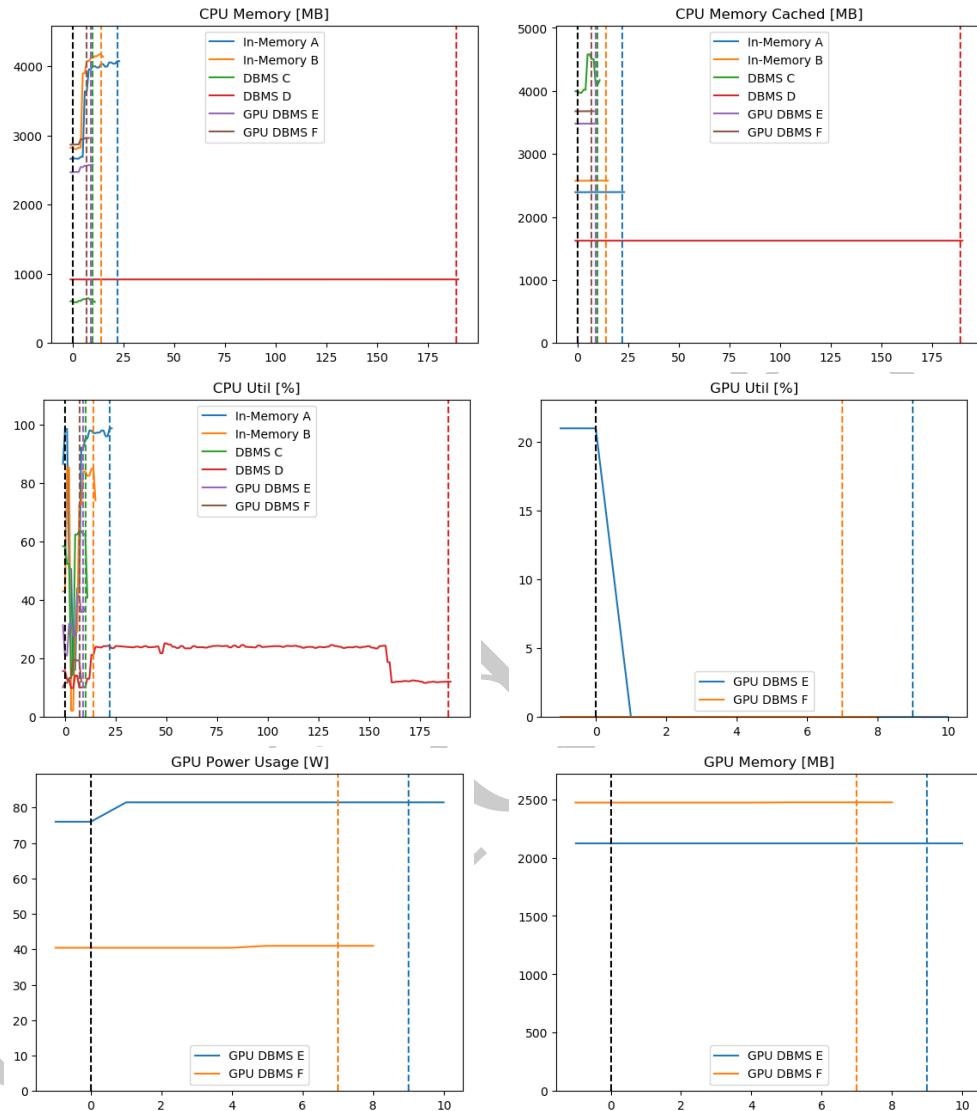


Figure 58: Query 17: Server Hardware Metrics

### 3.16.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS F	1.00	932.19	246.79	26.47	12.57	214.93	876.93	723.14	1,503.01
GPU DBMS E	1.36	1,264.58	214.49	16.96	7.96	195.04	1,243.79	1,047.03	1,771.85
DBMS C	1.73	1,609.49	245.46	15.25	10.93	360.69	1,515.12	1,181.06	1,922.38
In-Memory B	2.59	2,410.07	941.82	39.08	8.90	378.07	1,999.73	1,544.08	4,262.06
In-Memory A	4.26	3,971.87	1,153.77	29.05	3.73	263.24	3,538.86	2,919.00	6,232.22
DBMS D	40.28	37,545.57	4,449.54	11.85	0.08	58.10	37,075.46	31,634.05	44,861.48

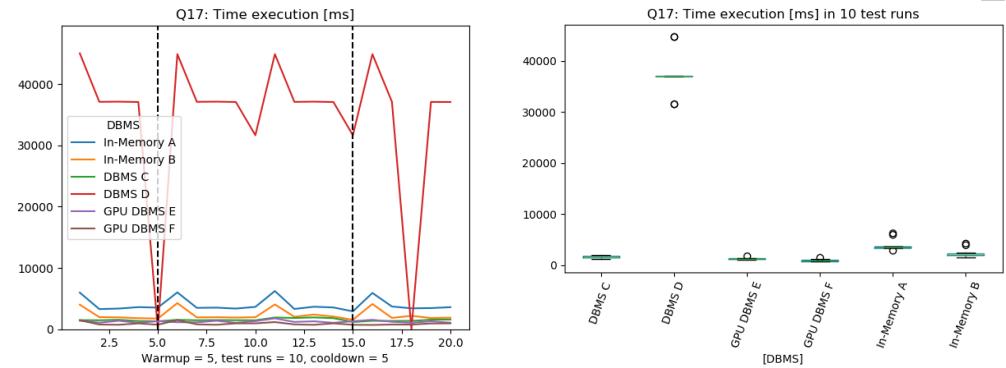


Figure 59: Query 17: Time execution

### 3.16.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS E	1.00	11.81	3.69	31.22	8.82	1.86	10.37	9.26	20.53
GPU DBMS F	1.08	12.73	2.76	21.66	19.78	5.01	12.43	9.77	16.82
DBMS C	1.31	15.45	5.54	35.85	29.39	8.99	13.11	10.29	25.43
DBMS D	1.48	17.47	8.12	46.51	27.15	8.78	14.21	10.21	35.44
In-Memory B	1.55	18.30	11.29	61.69	34.86	11.67	11.90	10.45	40.25
In-Memory A	1.57	18.60	13.50	72.57	26.58	8.20	12.98	10.60	55.07

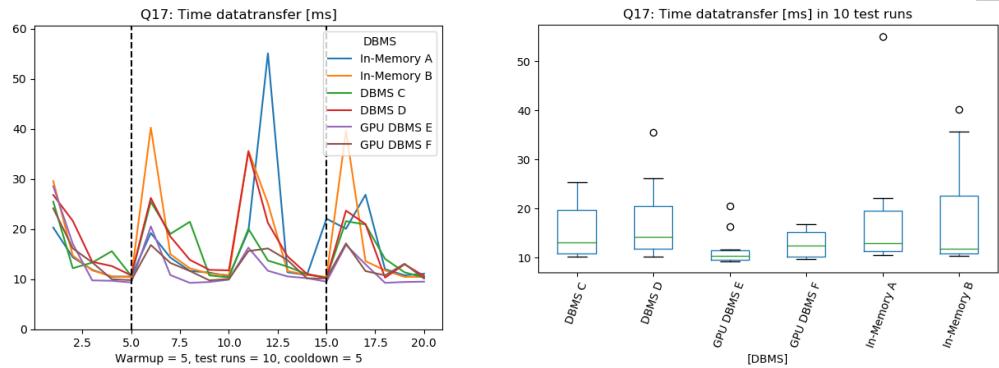


Figure 60: Query 17: Time datatransfer

### 3.16.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	500.75	11.52	2.30	2.18	21.86	500.75	489.82	511.68
DBMS C	1.36	680.17	10.31	1.52	1.44	19.56	680.17	670.39	689.95
In-Memory B	1.82	911.53	82.03	9.00	8.54	155.65	911.53	833.70	989.35
In-Memory A	1.86	931.65	5.54	0.59	0.56	10.51	931.65	926.40	936.91
GPU DBMS F	1.94	970.01	432.57	44.59	42.31	820.74	970.01	559.64	1,380.39
GPU DBMS E	1.96	980.45	139.35	14.21	13.48	264.40	980.45	848.25	1,112.65

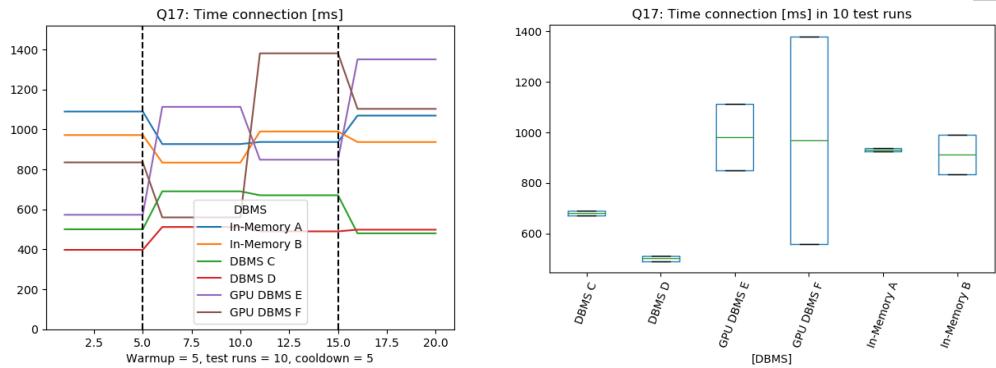


Figure 61: Query 17: Time connection

### 3.17 Query 18: Forecasting Revenue Change (TPC-H Q10)

Total Times:

- In-Memory A: 5,789.91ms = 00:00:06
- In-Memory B: 4,671.59ms = 00:00:05
- DBMS C: 5,880.81ms = 00:00:06
- DBMS D: 94,594.51ms = 00:01:35
- GPU DBMS E: 6,789.68ms = 00:00:07
- GPU DBMS F: 5,384.38ms = 00:00:06

```
select
c_custkey,
c_name,
sum(l_extendedprice * (1 - l_discount)) as revenue,
c_acctbal,
n_name,
c_address,
c_phone,
c_comment
from
customer,
orders,
lineitem,
nation
where
c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate >= date '{DATE}'
and o_orderdate < date '{DATE}' + interval '3' month
and l_returnflag = 'R'
and c_nationkey = n_nationkey
group by
c_custkey,
c_name,
c_acctbal,
c_phone,
n_name,
c_address,
c_comment
order by
revenue desc
limit 20
```

Results

### 3.17.1 Hardware Metrics

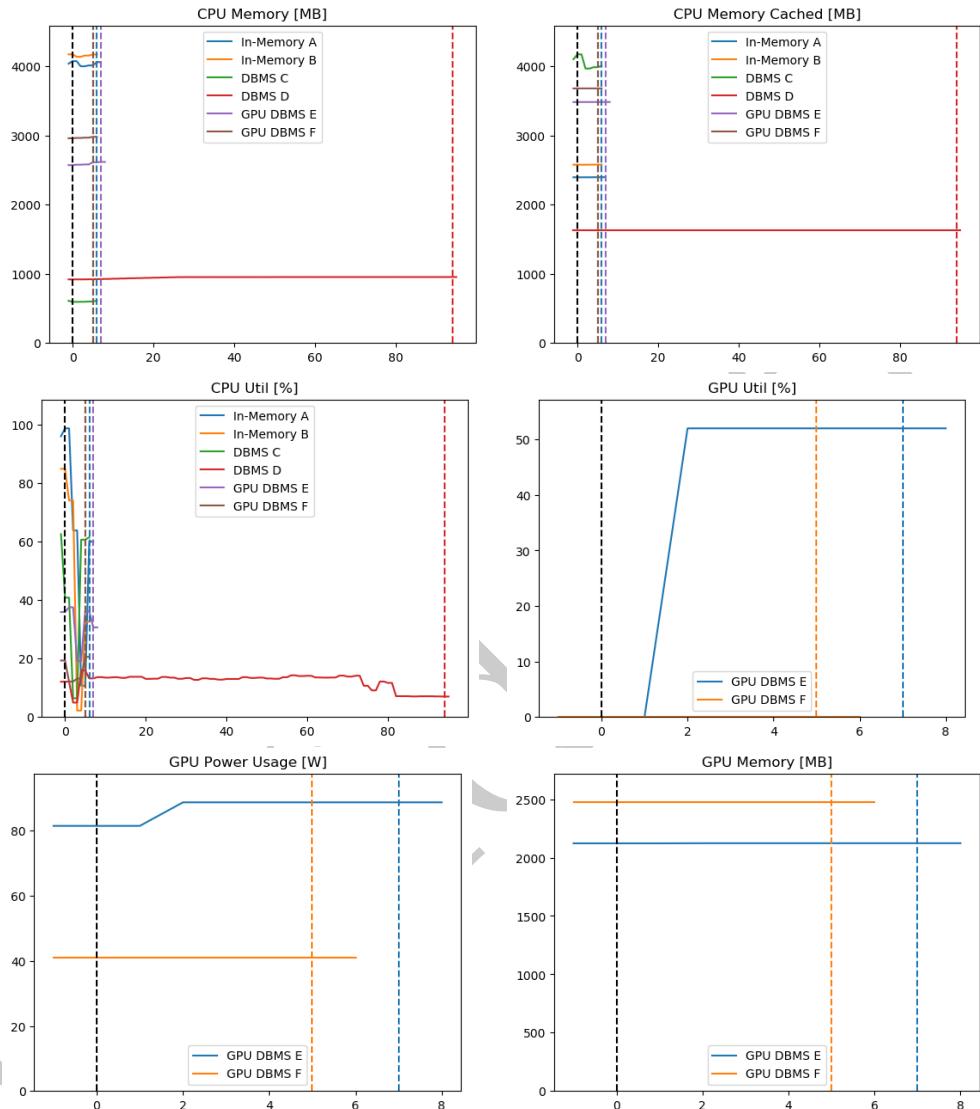


Figure 62: Query 18: Server Hardware Metrics

### 3.17.2 Time execution

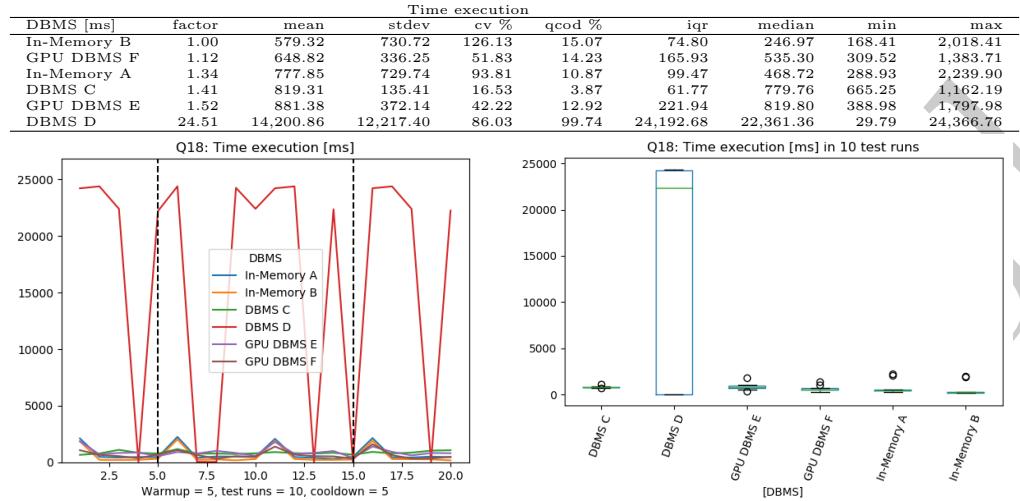


Figure 63: Query 18: Time execution

### 3.17.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS E	1.00	4.40	1.49	33.95	21.06	1.83	4.37	2.50	7.40
GPU DBMS F	1.04	4.59	1.82	39.71	29.98	2.73	3.88	2.65	7.80
In-Memory B	1.29	5.70	3.34	58.68	28.83	2.95	4.08	3.27	12.91
In-Memory A	1.37	6.01	2.88	47.94	25.27	2.62	5.08	3.21	11.57
DBMS C	1.38	6.06	2.54	41.88	20.99	2.26	5.91	3.24	11.53
DBMS D	1.43	6.30	2.72	43.18	32.03	3.79	5.63	3.40	10.95

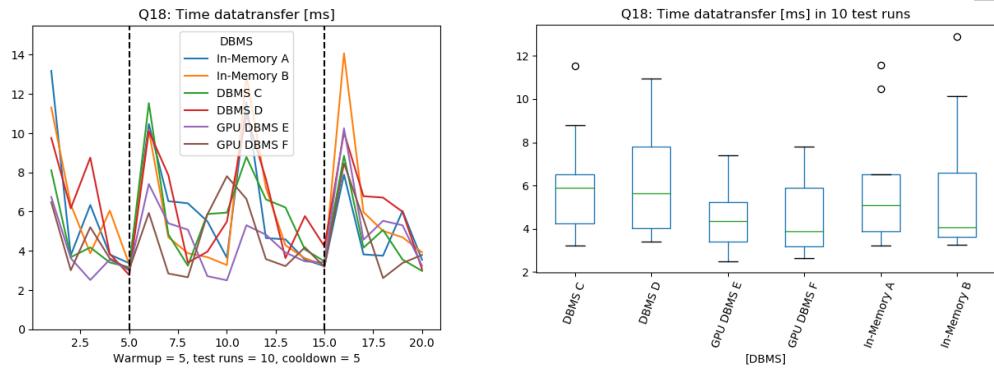


Figure 64: Query 18: Time datatransfer

### 3.17.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	447.80	80.16	17.90	16.98	152.09	447.80	371.76	523.85
DBMS C	1.56	698.68	21.49	3.08	2.92	40.77	698.68	678.30	719.07
GPU DBMS E	1.77	792.47	290.00	36.59	34.72	550.24	792.47	517.35	1,067.59
In-Memory B	2.03	908.71	77.26	8.50	8.07	146.59	908.71	835.42	982.00
In-Memory A	2.05	917.42	86.40	9.42	8.93	163.93	917.42	835.46	999.39
GPU DBMS F	2.11	944.26	432.23	45.77	43.43	820.10	944.26	534.21	1,354.30

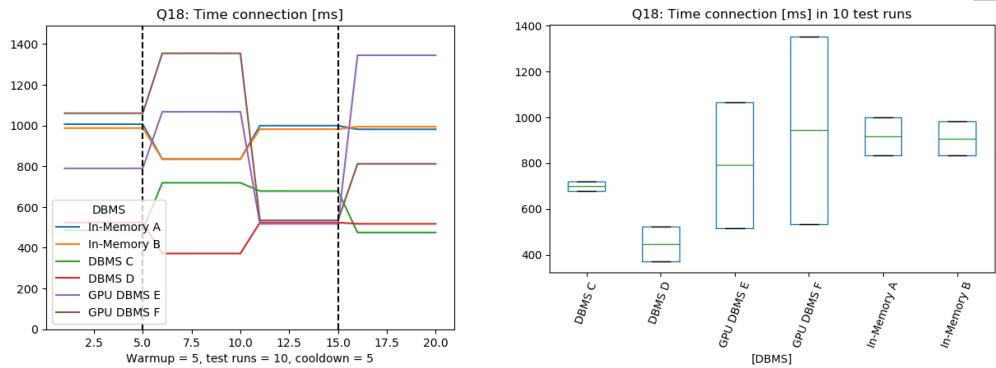


Figure 65: Query 18: Time connection

### 3.18 Query 19: Important Stock Identification (TPC-H Q11)

Total Times:

- In-Memory A: 4,795.16ms = 00:00:05
- In-Memory B: 4,688.24ms = 00:00:05
- DBMS C: 3,165.00ms = 00:00:04
- DBMS D: 37,380.81ms = 00:00:38
- GPU DBMS E: 6,991.96ms = 00:00:07
- GPU DBMS F: 7,096.68ms = 00:00:08

```
select
ps_partkey,
sum(ps_supplycost * ps_availqty) as v
from
partsupp,
supplier,
nation
where
ps_suppkey = s_suppkey
and s_nationkey = n_nationkey
and n_name = '{NATION}'
group by
ps_partkey having
sum(ps_supplycost * ps_availqty) > (
select
sum(ps_supplycost * ps_availqty) * {FRACTION}
from
partsupp,
supplier,
nation
where
ps_suppkey = s_suppkey
and s_nationkey = n_nationkey
and n_name = '{NATION}'
)
order by
v desc
limit 10000000
```

Results

### 3.18.1 Hardware Metrics

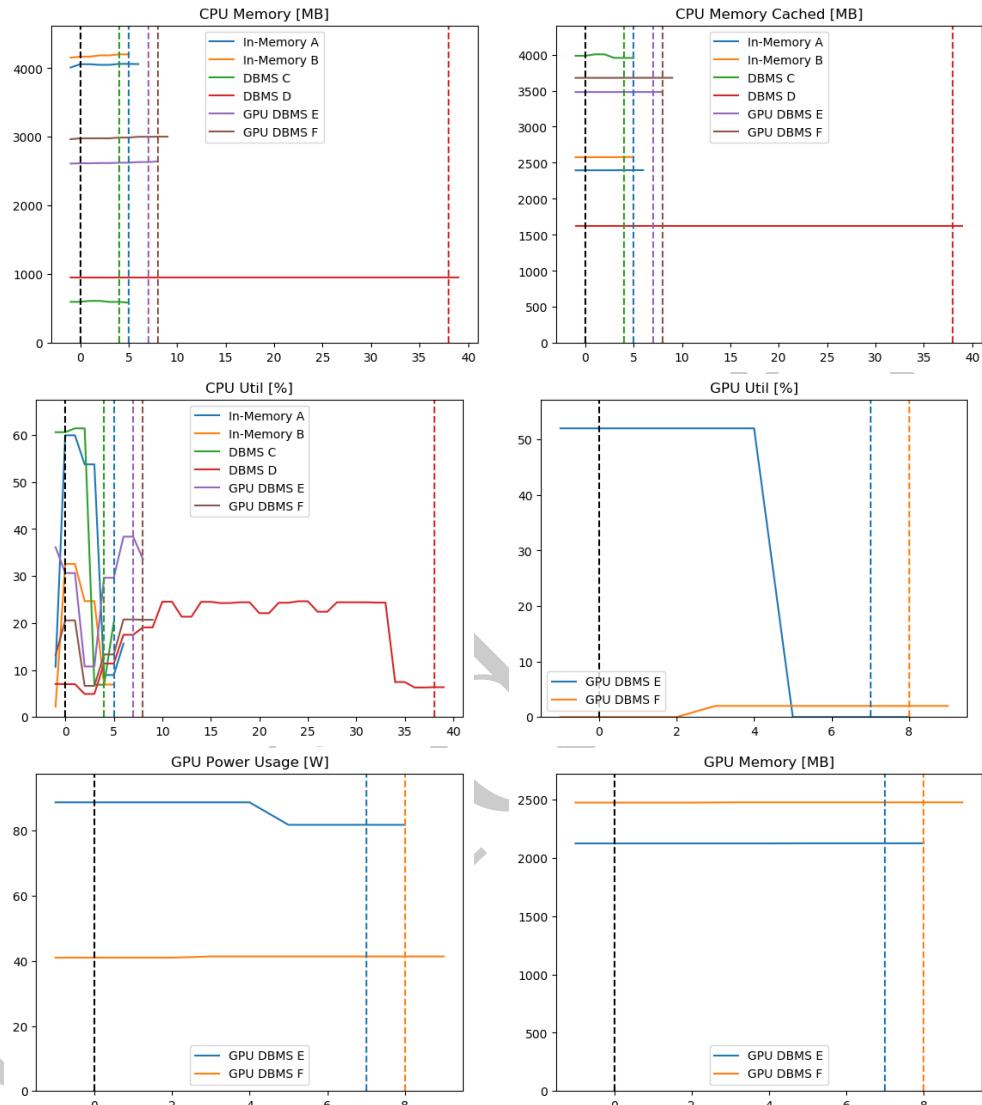


Figure 66: Query 19: Server Hardware Metrics

### 3.18.2 Time execution

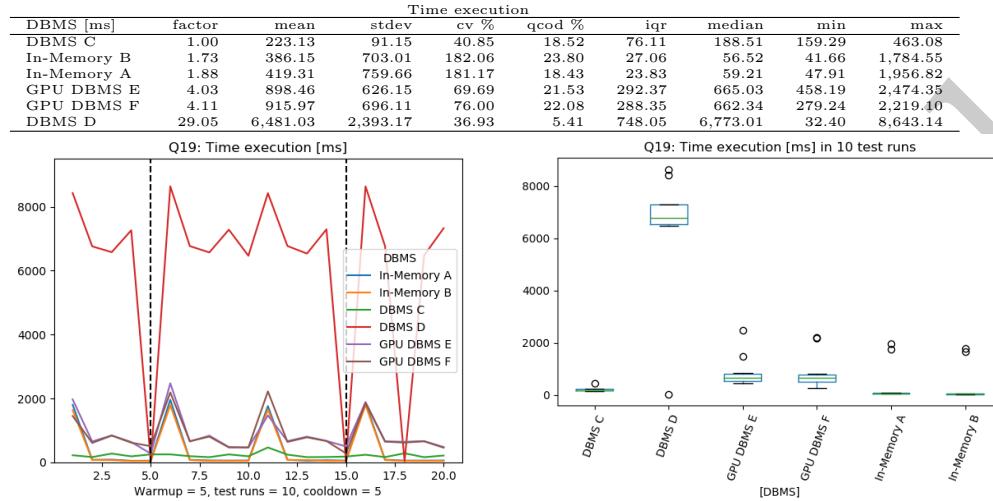


Figure 67: Query 19: Time execution

### 3.18.3 Time datatransfer

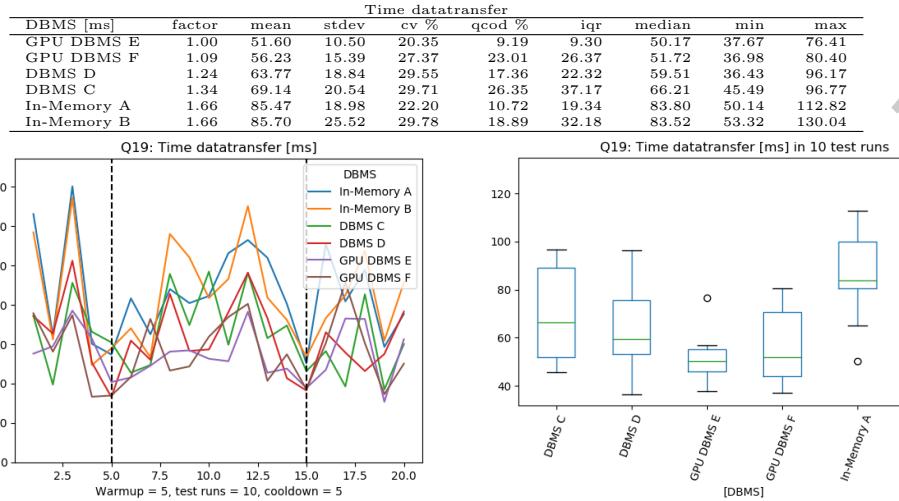


Figure 68: Query 19: Time datatransfer

### 3.18.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	487.13	111.92	22.98	21.80	212.35	487.13	380.95	593.30
DBMS C	1.22	596.22	116.18	19.49	18.49	220.43	596.22	486.00	706.43
GPU DBMS F	1.44	700.83	145.63	20.78	19.71	276.32	700.83	562.68	838.99
GPU DBMS E	1.62	789.98	290.92	36.83	34.94	551.97	789.98	513.99	1,065.96
In-Memory B	2.07	1,009.01	67.85	6.72	6.38	128.73	1,009.01	944.65	1,073.37
In-Memory A	2.09	1,017.71	72.10	7.08	6.72	136.79	1,017.71	949.31	1,086.11

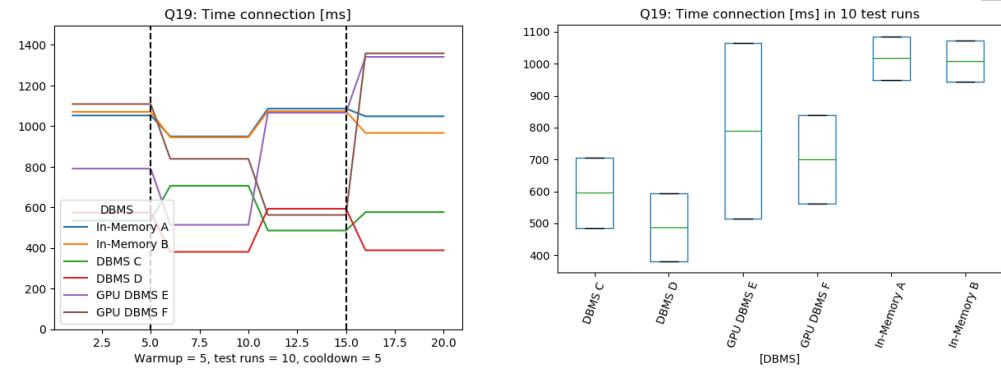


Figure 69: Query 19: Time connection

### 3.19 Query 20: Shipping Modes and Order Priority (TPC-H Q12)

Total Times:

- In-Memory A: 4,885.09ms = 00:00:05
- In-Memory B: 4,379.59ms = 00:00:05
- DBMS C: 6,079.50ms = 00:00:07
- DBMS D: 125,583.45ms = 00:02:06
- GPU DBMS E: 3,157.47ms = 00:00:04
- GPU DBMS F: 2,964.65ms = 00:00:03

```
select
l_shipmode,
sum(case
when o_orderpriority ='1-URGENT'
or o_orderpriority ='2-HIGH'
then 1.0
else 0.0
end) as high_line_count,
sum(case
when o_orderpriority <> '1-URGENT'
and o_orderpriority <> '2-HIGH'
then 1.0
else 0.0
end) as low_line_count
from
orders,
lineitem
where
o_orderkey = l_orderkey
and l_shipmode in ('{SHIPMODE1}', '{SHIPMODE2}')
and l_commitdate < l_receiptdate
and l_shipdate < l_commitdate
and l_receiptdate >= date '{DATE}'
and l_receiptdate < date '{DATE}' + interval '1' year
group by
l_shipmode
order by
l_shipmode
limit 10000000
```

Results

### 3.19.1 Hardware Metrics

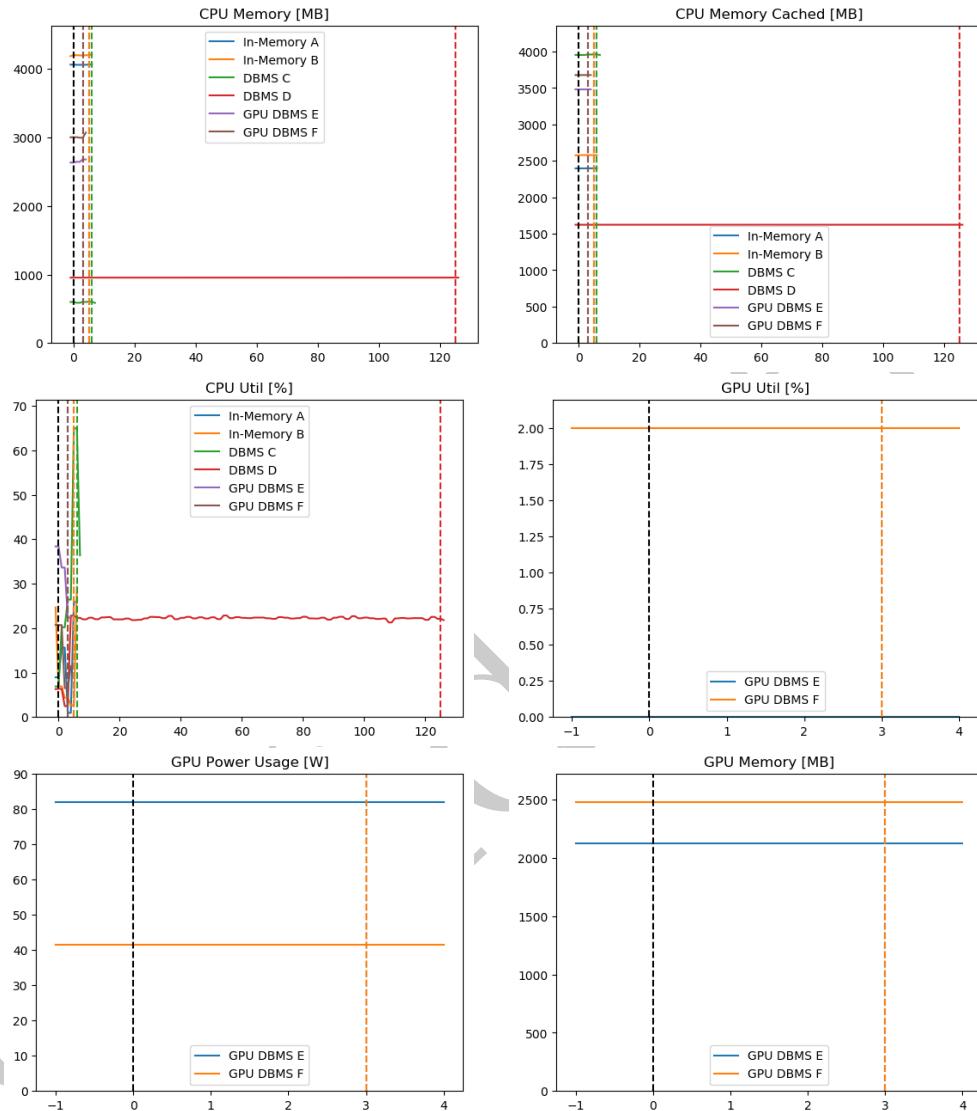


Figure 70: Query 20: Server Hardware Metrics

### 3.19.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS F	1.00	279.11	455.56	163.22	8.57	11.84	66.34	59.56	1,287.65
GPU DBMS E	1.10	308.34	445.00	144.32	12.90	26.47	110.91	73.77	1,266.15
In-Memory B	1.68	467.61	729.50	156.01	9.52	24.82	132.04	84.21	1,871.03
In-Memory A	2.06	576.13	748.10	129.85	4.69	21.72	226.38	195.65	2,055.04
DBMS C	2.60	726.38	86.66	11.93	8.58	124.51	719.43	618.57	856.90
DBMS D	89.09	24,865.25	440.09	1.77	0.03	15.92	25,074.39	23,970.78	25,079.82

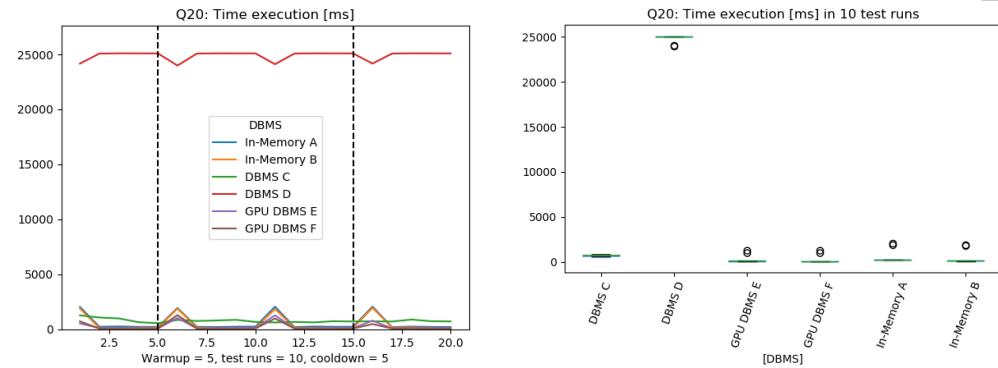


Figure 71: Query 20: Time execution

### 3.19.3 Time datatransfer

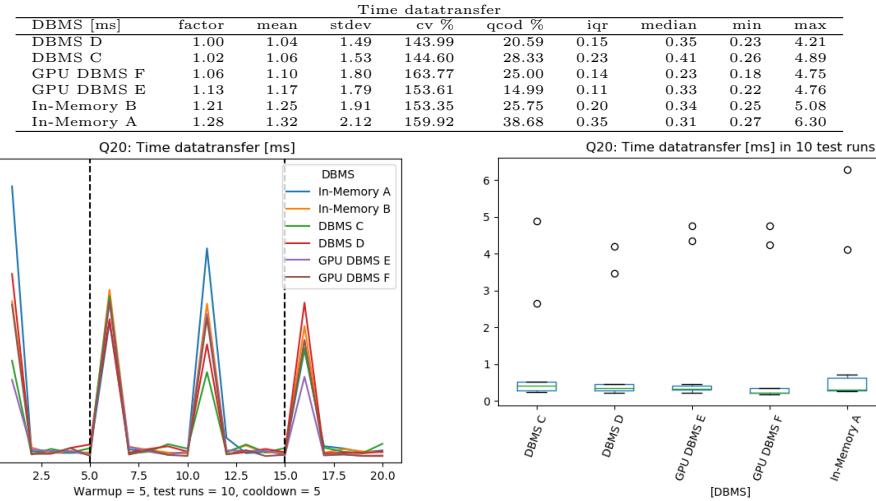


Figure 72: Query 20: Time datatransfer

### 3.19.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	500.53	53.50	10.69	10.14	101.52	500.53	449.77	551.28
DBMS C	1.10	552.85	2.44	0.44	0.42	4.63	552.85	550.53	555.16
GPU DBMS F	1.32	658.55	138.01	20.96	19.88	261.85	658.55	527.63	789.47
GPU DBMS E	1.35	677.77	152.24	22.46	21.31	288.85	677.77	533.35	822.19
In-Memory B	2.01	1,007.90	53.25	5.28	5.01	101.04	1,007.90	957.38	1,058.42
In-Memory A	2.15	1,075.73	50.77	4.72	4.48	96.34	1,075.73	1,027.56	1,123.89

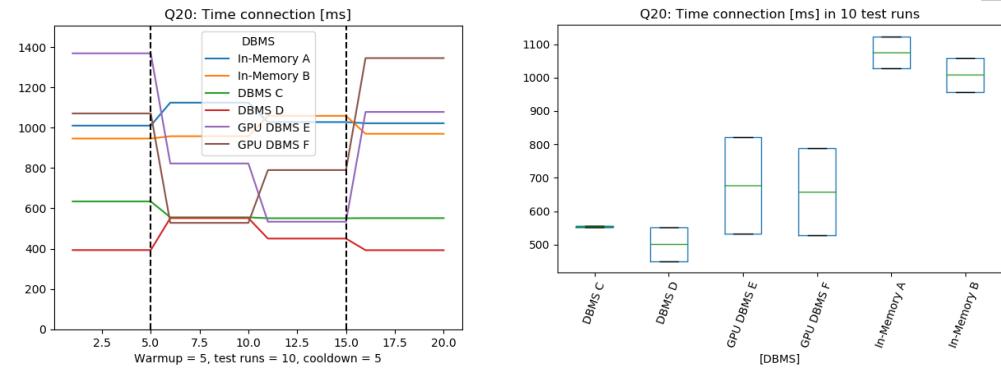


Figure 73: Query 20: Time connection

### 3.20 Query 21: Customer Distribution (TPC-H Q13)

Total Times:

- In-Memory A: 5,885.27ms = 00:00:06
- In-Memory B: 4,784.67ms = 00:00:05
- DBMS C: 6,387.45ms = 00:00:07
- DBMS D: 17,448.61ms = 00:00:18
- GPU DBMS E: 7,394.61ms = 00:00:08
- GPU DBMS F: 6,385.38ms = 00:00:07

```
select
c.count, count(*) as custdist
from (
select
c.custkey c_custkey,
count(o_orderkey) c_count
from
customer left outer join orders on
c.custkey = o.custkey
where o_comment not like '%{WORD1} %{WORD2}%
group by
c.custkey
)as c_orders
group by
c.count
order by
custdist desc,
c.count desc
limit 10000000
```

Results

### 3.20.1 Hardware Metrics

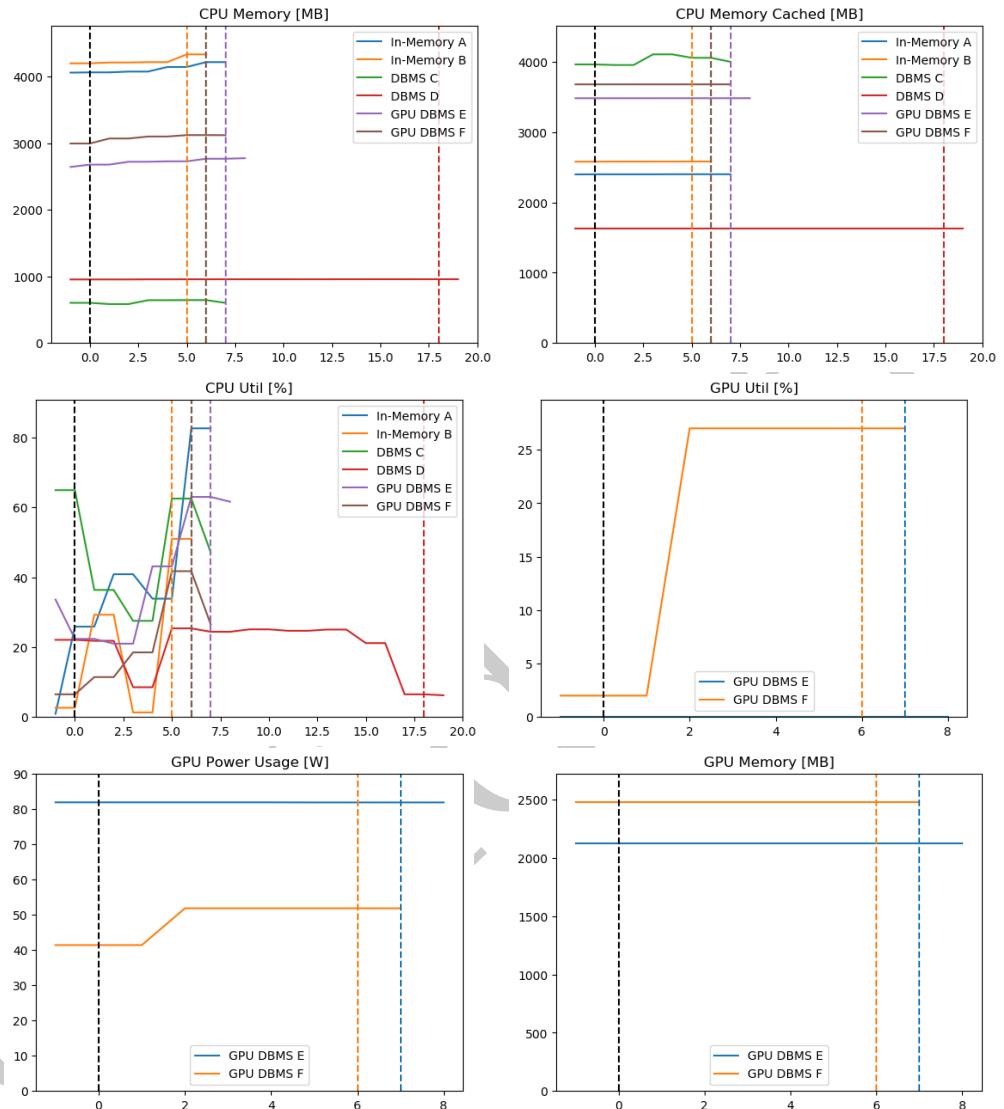


Figure 74: Query 21: Server Hardware Metrics

### 3.20.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
In-Memory B	1.00	550.33	433.97	78.86	5.51	39.79	350.30	307.59	1,380.54
In-Memory A	1.44	794.62	393.64	49.54	4.99	62.49	618.62	559.26	1,602.15
GPU DBMS F	1.53	842.06	405.62	48.17	18.48	295.50	875.49	140.19	1,550.47
DBMS C	1.65	908.35	156.45	17.22	13.39	249.67	874.16	658.30	1,118.42
GPU DBMS E	1.91	1,053.14	635.00	60.30	29.79	569.54	1,186.51	194.82	2,368.71
DBMS D	4.34	2,389.16	2,045.85	85.63	98.59	4,042.08	3,569.21	28.24	4,290.18

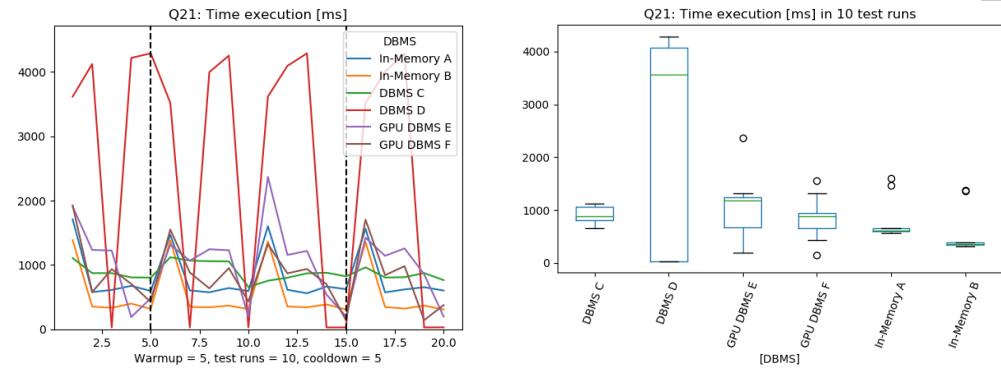


Figure 75: Query 21: Time execution

### 3.20.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS E	1.00	2.93	1.76	60.15	12.51	0.56	2.09	1.91	6.48
DBMS D	1.05	3.08	1.29	41.88	21.27	1.17	2.78	1.96	6.19
DBMS C	1.18	3.47	1.47	42.32	14.20	0.89	2.98	2.34	7.23
GPU DBMS F	1.24	3.65	1.75	47.98	34.11	2.28	3.06	2.02	6.61
In-Memory A	1.58	4.62	1.87	40.37	14.97	1.23	4.15	2.72	8.06
In-Memory B	1.66	4.87	2.00	41.11	17.48	1.67	4.32	2.25	8.21

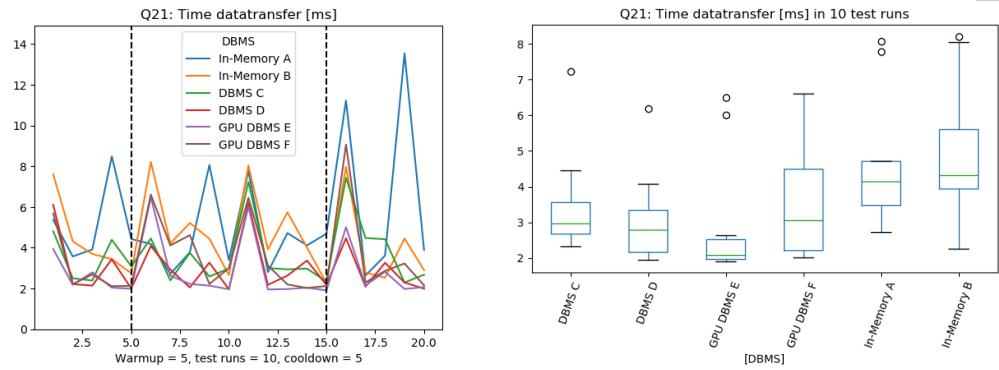


Figure 76: Query 21: Time datatransfer

### 3.20.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	475.45	102.59	21.58	20.47	194.66	475.45	378.12	572.78
DBMS C	1.20	572.80	85.08	14.85	14.09	161.43	572.80	492.08	653.51
GPU DBMS E	1.48	702.54	153.64	21.87	20.75	291.51	702.54	556.78	848.30
GPU DBMS F	1.79	851.39	288.34	33.87	32.13	547.08	851.39	577.85	1,124.93
In-Memory B	2.12	1,005.75	8.27	0.82	0.78	15.70	1,005.75	997.91	1,013.60
In-Memory A	2.24	1,066.17	70.27	6.59	6.25	133.32	1,066.17	999.51	1,132.84

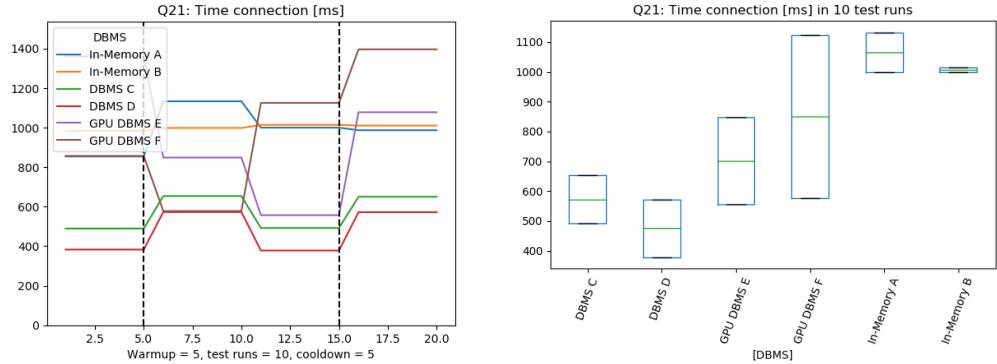


Figure 77: Query 21: Time connection

### 3.21 Query 22: Forecasting Revenue Change (TPC-H Q14)

Total Times:

- In-Memory A: 3,865.80ms = 00:00:04
- In-Memory B: 3,470.52ms = 00:00:04
- DBMS C: 4,466.59ms = 00:00:05
- DBMS D: 104,472.66ms = 00:01:45
- GPU DBMS E: 3,255.25ms = 00:00:04
- GPU DBMS F: 2,970.45ms = 00:00:03

```
select
100.00 * sum(case
when p_type like 'PROMO%'
then l_extendedprice*(1-l_discount)
else 0
end) / sum(l_extendedprice * (1 - l_discount)) as promo_revenue
from
lineitem,
part
where
l_partkey = p_partkey
and l_shipdate >= date '{DATE}'
and l_shipdate < date '{DATE}' + interval '1' month
limit 10000000
```

#### 3.21.1 Error

GPU DBMS E: numRun 1: : java.sql.SQLException: Query failed : Exception: Overflow or underflow

GPU DBMS F: numRun 1: : java.sql.SQLException: Query failed : Exception: Overflow or underflow

Results

### 3.21.2 Hardware Metrics

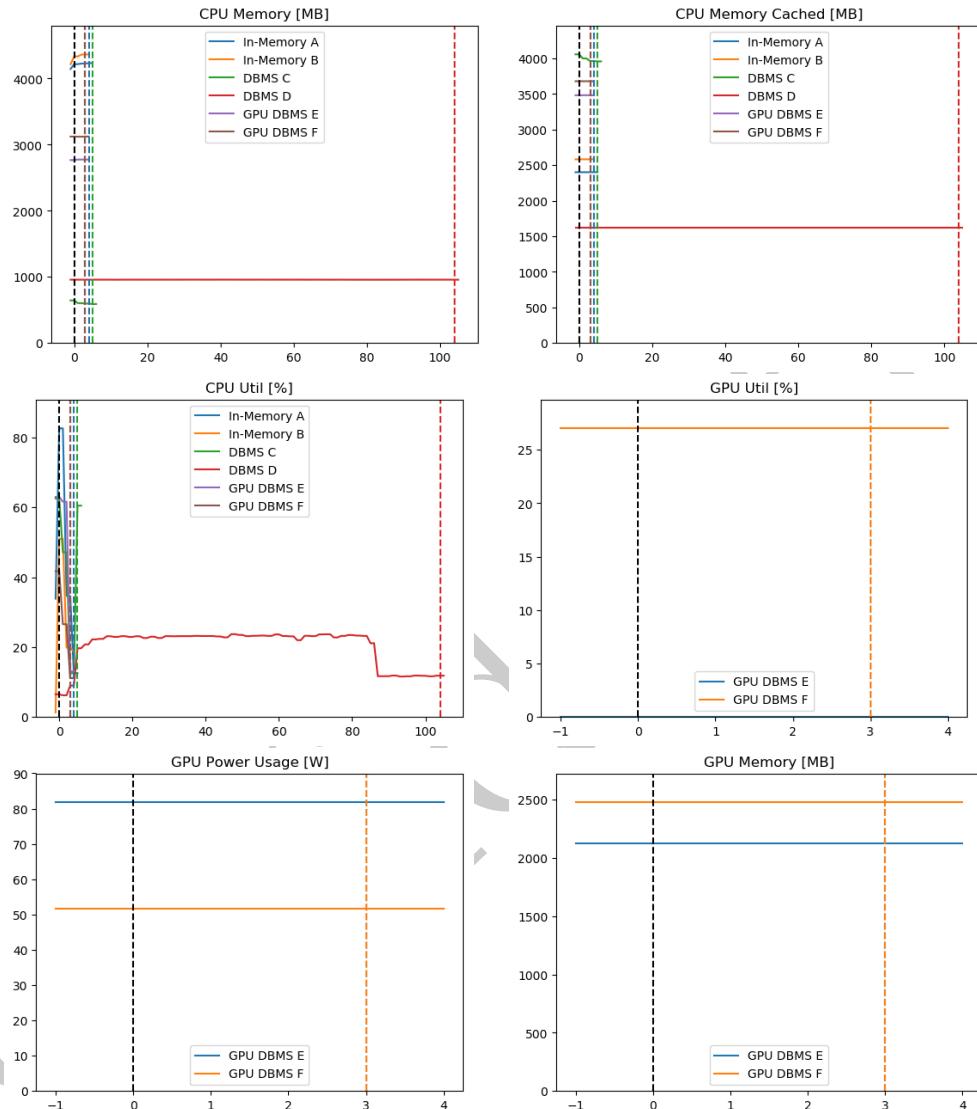


Figure 78: Query 22: Server Hardware Metrics

### 3.21.3 Time execution

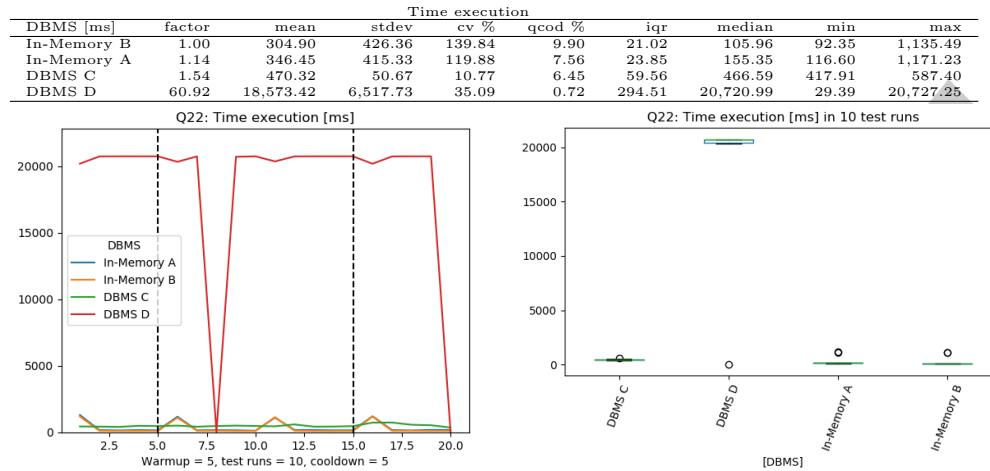


Figure 79: Query 22: Time execution

### 3.21.4 Time datatransfer

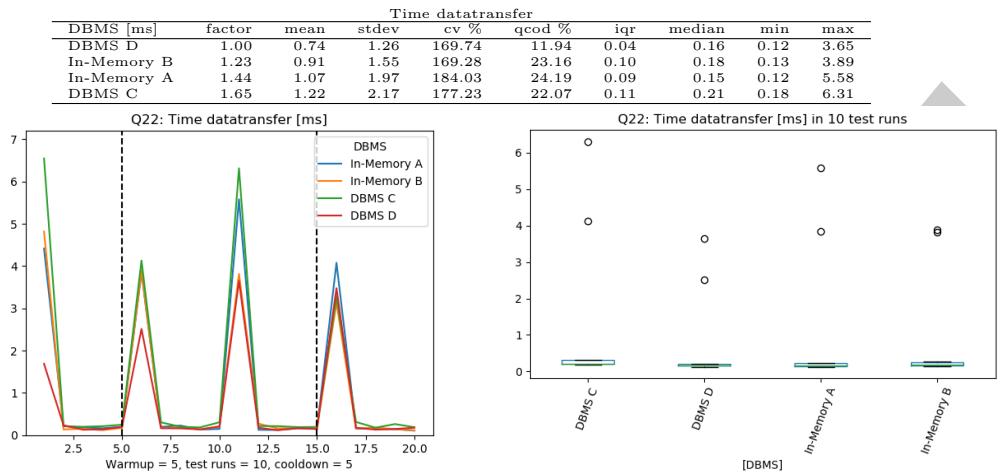


Figure 80: Query 22: Time datatransfer

### 3.21.5 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	437.75	9.45	2.16	2.05	17.93	437.75	428.78	446.72
DBMS C	1.25	546.31	21.55	3.94	3.74	40.88	546.31	525.87	566.75
In-Memory B	2.23	977.50	16.91	1.73	1.64	32.08	977.50	961.46	993.54
In-Memory A	2.52	1,104.04	24.88	2.25	2.14	47.21	1,104.04	1,080.44	1,127.65

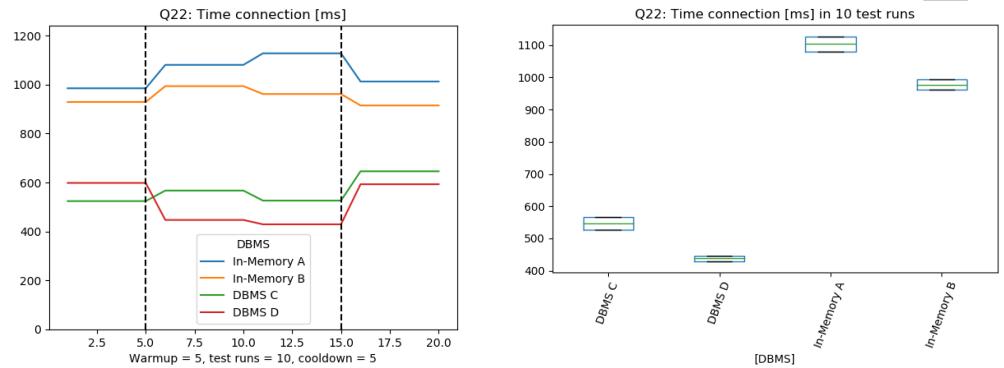


Figure 81: Query 22: Time connection

### 3.22 Query 24: Parts/Supplier Relationship (TPC-H Q16)

Total Times:

- In-Memory A: 18,789.29ms = 00:00:19
- In-Memory B: 17,062.56ms = 00:00:18
- DBMS C: 17,469.31ms = 00:00:18
- DBMS D: 21,589.43ms = 00:00:22
- GPU DBMS E: 20,794.02ms = 00:00:21
- GPU DBMS F: 21,004.54ms = 00:00:22

```
select
    p.brand,
    p.type,
    p.size,
    count(distinct ps_suppkey) as supplier_cnt
from
    partsupp,
    part
where
    p_partkey = ps_partkey
    and p_brand <> '{BRAND}'
    and p_type not like '{TYPE}%'
    and p_size in ({SIZE1}, {SIZE2}, {SIZE3}, {SIZE4}, {SIZE5}, {SIZE6}, {SIZE7}, {SIZE8})
    and ps_suppkey not in (
        select
            s_suppkey
        from
            supplier
        where
            s_comment like '%Customer%Complaints%'
    )
group by
    p.brand,
    p.type,
    p.size
order by
    supplier_cnt desc,
    p.brand,
    p.type,
    p.size
limit 10000000
```

Results

### 3.22.1 Hardware Metrics

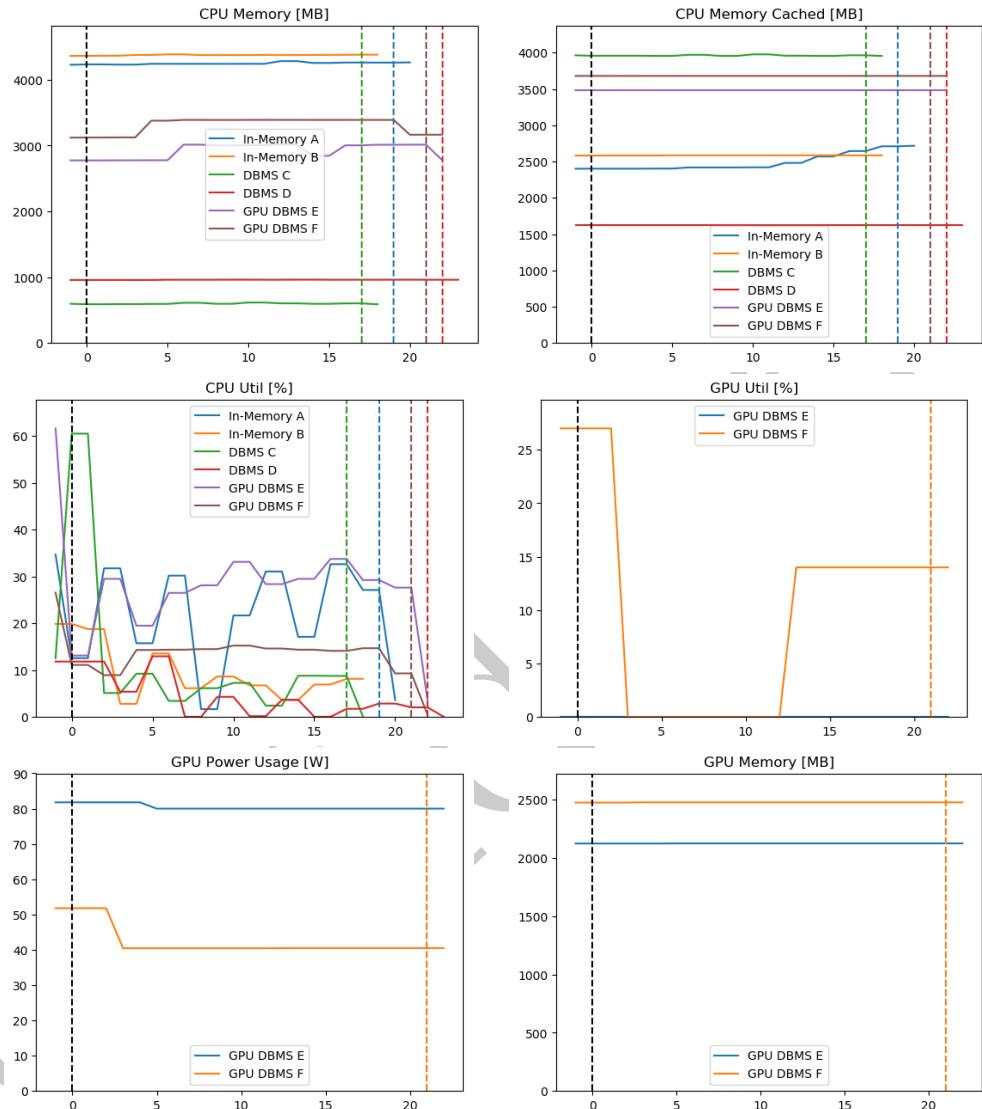


Figure 82: Query 24: Server Hardware Metrics

### 3.22.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS C	1.00	991.06	252.10	25.44	8.09	154.93	904.41	770.89	1,651.63
In-Memory B	1.01	1,001.50	1,062.34	106.07	26.49	303.40	540.79	359.29	3,074.05
DBMS D	1.14	1,128.42	660.68	58.55	50.94	1,185.05	827.18	529.93	2,087.40
In-Memory A	1.36	1,352.37	1,043.58	77.17	9.67	170.75	898.36	765.30	3,409.11
GPU DBMS F	1.77	1,749.74	841.32	48.08	4.33	123.04	1,444.96	1,198.81	3,882.98
GPU DBMS E	1.78	1,760.58	1,020.27	57.95	6.00	163.75	1,365.34	1,149.09	4,376.20

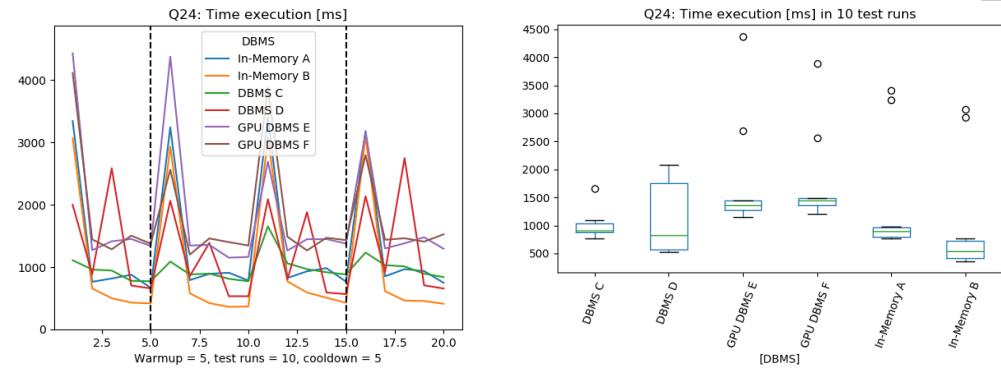


Figure 83: Query 24: Time execution

### 3.22.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS E	1.00	1,205.06	87.62	7.27	4.35	103.98	1,181.26	1,117.05	1,371.64
GPU DBMS F	1.01	1,222.76	83.13	6.80	4.68	114.54	1,191.54	1,128.84	1,376.48
In-Memory B	1.11	1,337.46	128.67	9.62	7.16	191.74	1,291.94	1,189.98	1,578.07
In-Memory A	1.12	1,347.15	79.83	5.93	5.47	148.85	1,310.32	1,253.50	1,446.34
DBMS C	1.22	1,475.47	288.21	19.53	17.43	528.91	1,295.57	1,185.34	1,855.69
DBMS D	1.50	1,802.10	533.28	29.59	23.06	810.51	1,624.43	1,189.94	2,618.77

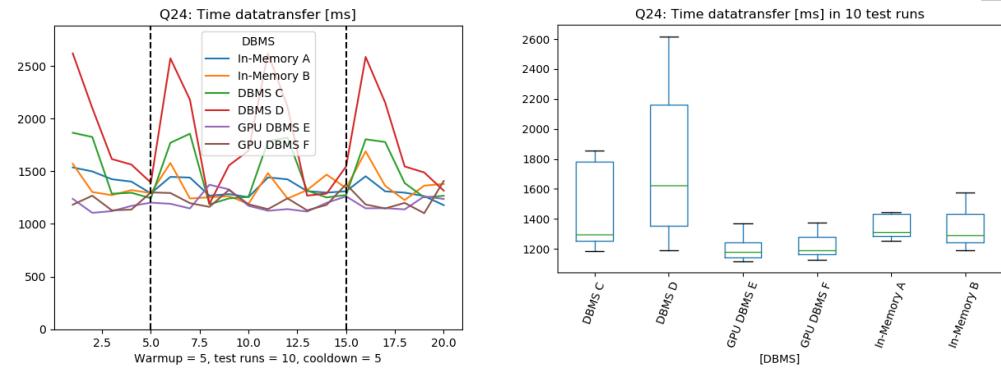


Figure 84: Query 24: Time datatransfer

### 3.22.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	424.07	38.06	8.98	8.51	72.22	424.07	387.97	460.18
DBMS C	1.35	570.51	65.48	11.48	10.89	124.25	570.51	508.38	632.63
GPU DBMS F	1.66	702.24	138.77	19.76	18.75	263.29	702.24	570.60	833.89
In-Memory B	2.35	994.68	12.25	1.23	1.17	23.25	994.68	983.06	1,006.31
In-Memory A	2.41	1,021.03	1.32	0.13	0.12	2.50	1,021.03	1,019.78	1,022.28
GPU DBMS E	2.59	1,097.62	269.03	24.51	23.25	510.46	1,097.62	842.39	1,352.85

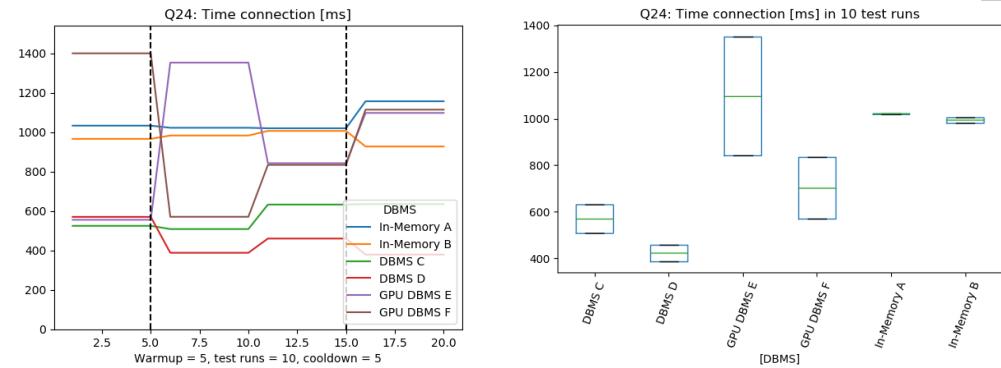


Figure 85: Query 24: Time connection

### 3.23 Query 26: Large Volume Customer (TPC-H Q18)

Total Times:

- In-Memory A: 11,823.40ms = 00:00:12
- In-Memory B: 7,696.98ms = 00:00:08
- DBMS C: 27,130.34ms = 00:00:28
- DBMS D: 25,521.67ms = 00:00:26
- GPU DBMS E: 38,502.54ms = 00:00:39
- GPU DBMS F: 23,190.31ms = 00:00:24

```
select
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice ,
cast(sum(l_quantity) as int) as sum_quant
from
customer,
orders,
lineitem
where
o_orderkey in (
select
l_orderkey
from
lineitem
group by
l_orderkey having
sum(l_quantity) > {QUANTITY}
)
and c_custkey = o_custkey
and o_orderkey = l_orderkey
group by
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice
order by
o_totalprice desc,
o_orderdate
limit 10000000
```

Results

### 3.23.1 Hardware Metrics

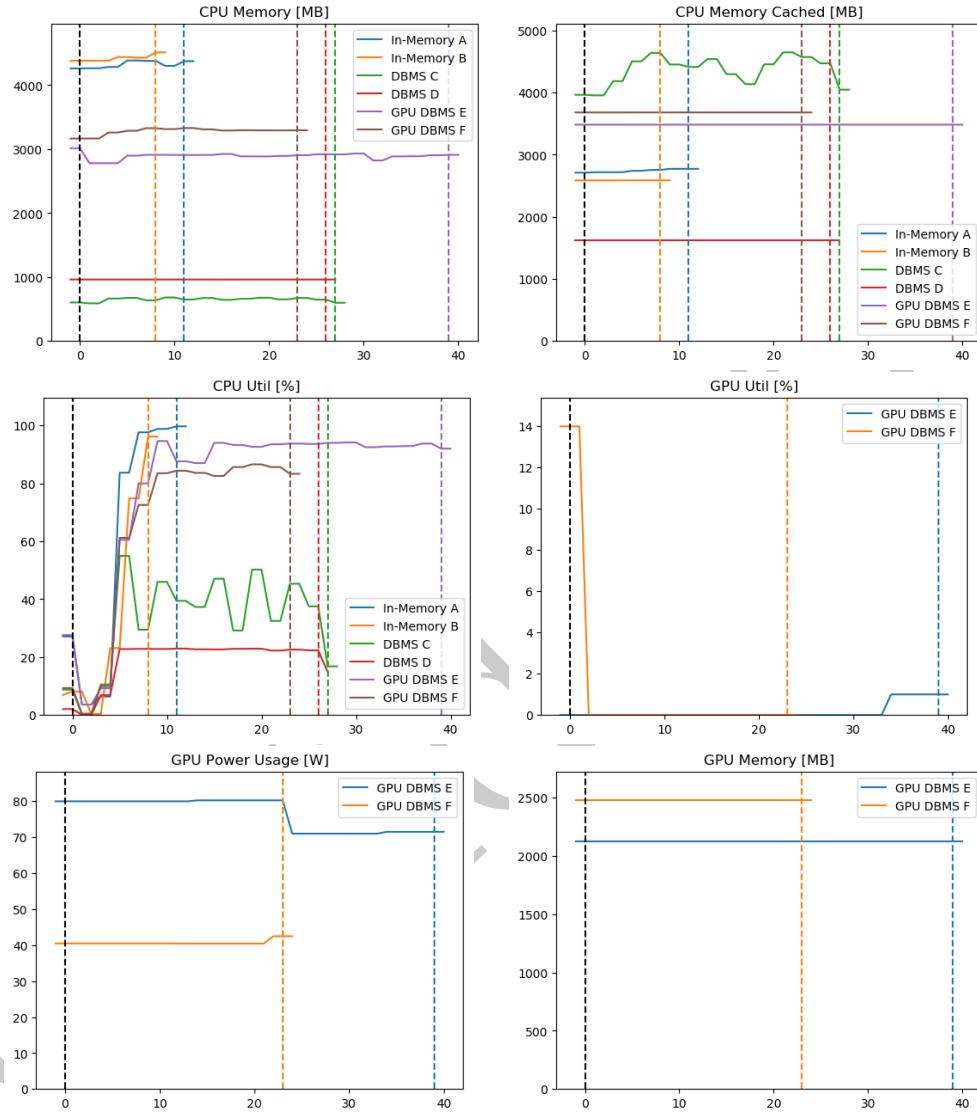


Figure 86: Query 26: Server Hardware Metrics

### 3.23.2 Time execution

Time execution									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
In-Memory B	1.00	1,193.20	512.30	42.94	8.55	171.89	965.46	838.32	2,241.26
In-Memory A	1.68	2,008.92	541.68	26.96	2.76	98.29	1,773.02	1,680.24	3,032.48
GPU DBMS F	3.37	4,021.62	275.80	6.86	0.80	62.50	3,910.00	3,871.54	4,734.48
DBMS C	3.87	4,614.50	138.16	2.99	1.94	178.58	4,604.30	4,429.16	4,812.94
DBMS D	4.06	4,850.15	10,160.05	209.48	4.02	2.53	30.91	29.77	24,129.14
GPU DBMS E	5.85	6,984.09	715.67	10.25	0.53	73.98	7,011.85	5,387.37	8,394.55

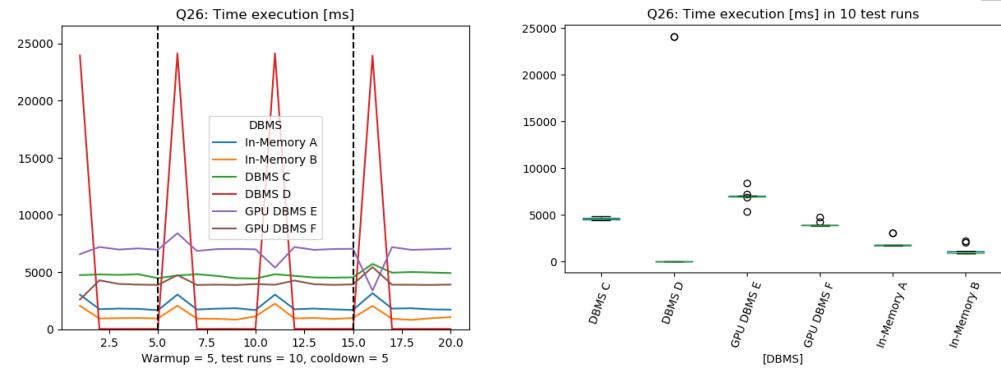


Figure 87: Query 26: Time execution

### 3.23.3 Time datatransfer

Time datatransfer									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
GPU DBMS E	1.00	3.52	4.48	127.35	7.49	0.22	1.41	1.32	13.30
GPU DBMS F	1.07	3.77	4.91	130.24	6.02	0.18	1.45	1.33	13.52
In-Memory A	1.24	4.37	4.81	110.00	6.72	0.29	2.16	1.92	14.81
DBMS D	1.28	4.49	3.45	76.73	15.76	0.98	3.00	2.40	12.21
DBMS C	1.29	4.54	5.07	111.58	6.27	0.30	2.30	2.15	17.31
In-Memory B	1.37	4.82	4.93	102.37	25.38	1.43	2.54	2.00	15.30

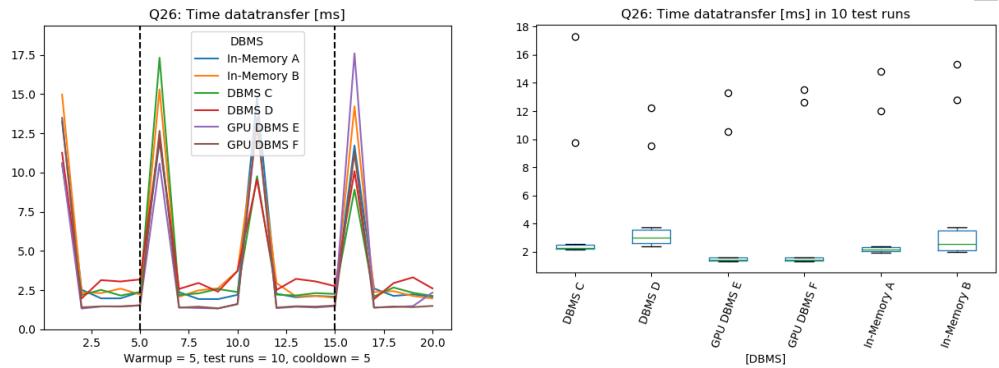


Figure 88: Query 26: Time datatransfer

### 3.23.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	426.95	5.23	1.23	1.16	9.92	426.95	421.99	431.91
DBMS C	1.54	656.80	93.75	14.27	13.54	177.88	656.80	567.86	745.74
GPU DBMS F	1.85	790.01	273.30	34.59	32.82	518.54	790.01	530.74	1,049.28
In-Memory B	2.10	897.38	84.94	9.47	8.98	161.16	897.38	816.80	977.97
GPU DBMS E	2.21	944.26	431.83	45.73	43.39	819.35	944.26	534.59	1,353.94
In-Memory A	2.31	987.25	18.09	1.83	1.74	34.33	987.25	970.09	1,004.42

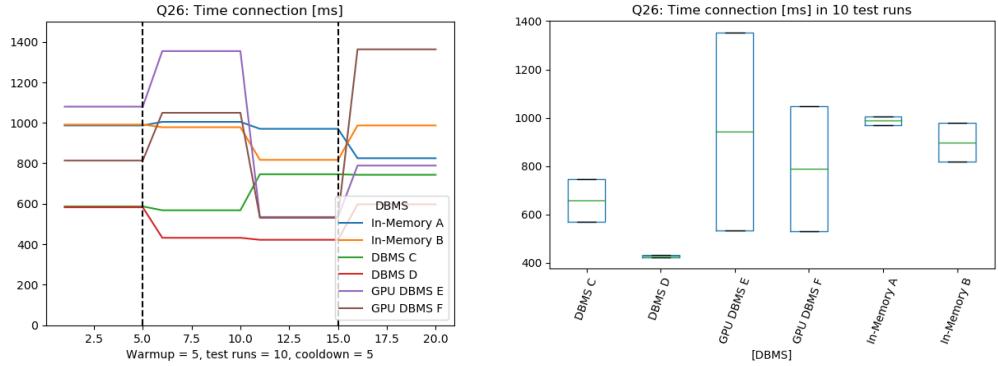


Figure 89: Query 26: Time connection

### 3.24 Query 27: Discounted Revenue (TPC-H Q19)

Total Times:

- In-Memory A: 5,880.41ms = 00:00:06
- In-Memory B: 6,082.60ms = 00:00:07
- DBMS C: 5,475.45ms = 00:00:06
- DBMS D: 105,895.41ms = 00:01:46
- GPU DBMS E: 4,063.68ms = 00:00:05
- GPU DBMS F: 3,671.85ms = 00:00:04

```
select
sum(l_extendedprice * (1 - l_discount) ) as revenue
from
lineitem,
part
where
(
p_partkey = l_partkey
and p_brand = '{BRAND1}'
and p_container in ('SM_CASE', 'SM_BOX', 'SM_PACK', 'SM_PKG')
and l_quantity >= {QUANTITY1} and l_quantity <= {QUANTITY1} + 10
and p_size between 1 and 5
and l_shipmode in ('AIR', 'AIR_REG')
and l_shipinstruct = 'DELIVER_IN_PERSON'
)
or
(
p_partkey = l_partkey
and p_brand = '{BRAND2}'
and p_container in ('MED_BAG', 'MED_BOX', 'MED_PKG', 'MED_PACK')
and l_quantity >= {QUANTITY2} and l_quantity <= {QUANTITY2} + 10
and p_size between 1 and 10
and l_shipmode in ('AIR', 'AIR_REG')
and l_shipinstruct = 'DELIVER_IN_PERSON'
)
or
(
p_partkey = l_partkey
and p_brand = '{BRAND3}'
and p_container in ('LG_CASE', 'LG_BOX', 'LG_PACK', 'LG_PKG')
and l_quantity >= {QUANTITY3} and l_quantity <= {QUANTITY3} + 10
and p_size between 1 and 15
and l_shipmode in ('AIR', 'AIR_REG')
and l_shipinstruct = 'DELIVER_IN_PERSON'
limit 10000000
```

Results

### 3.24.1 Hardware Metrics

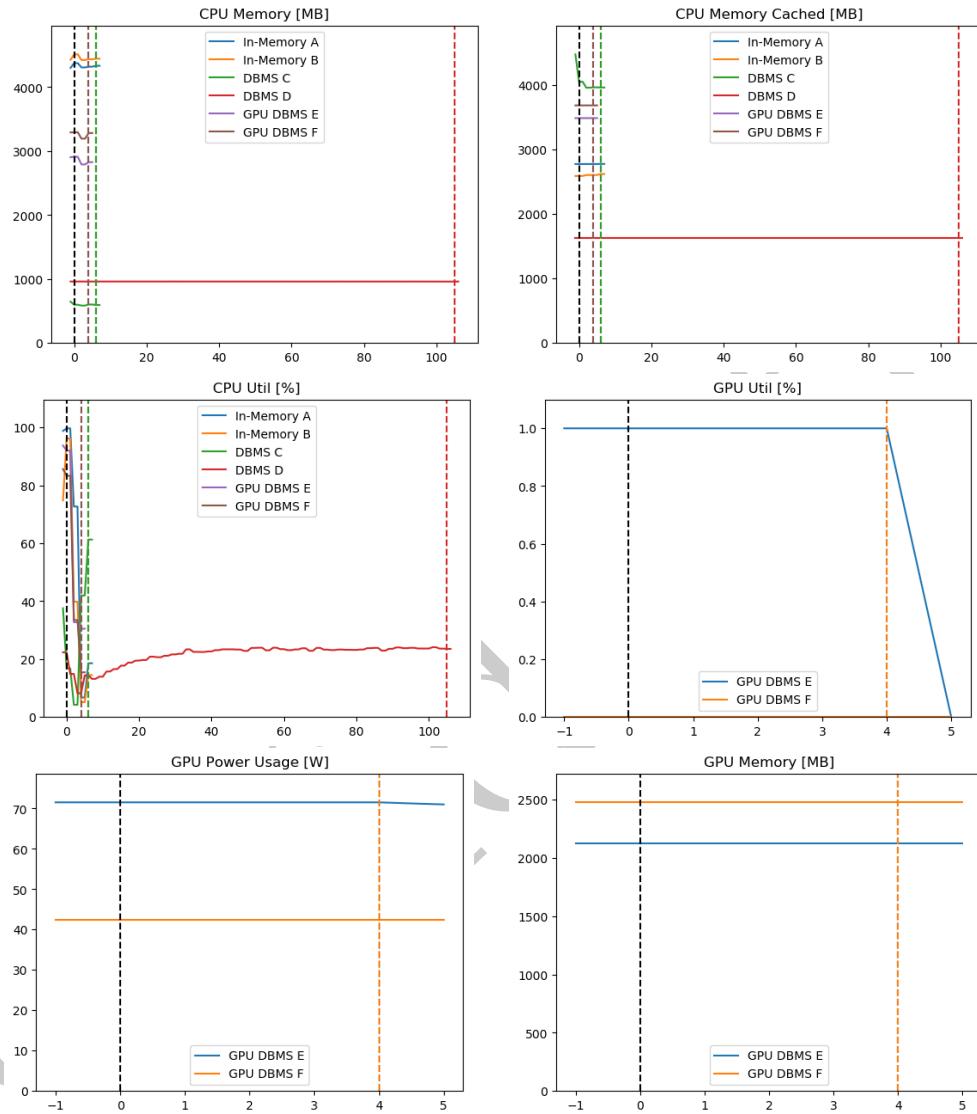


Figure 90: Query 27: Server Hardware Metrics

### 3.24.2 Time execution

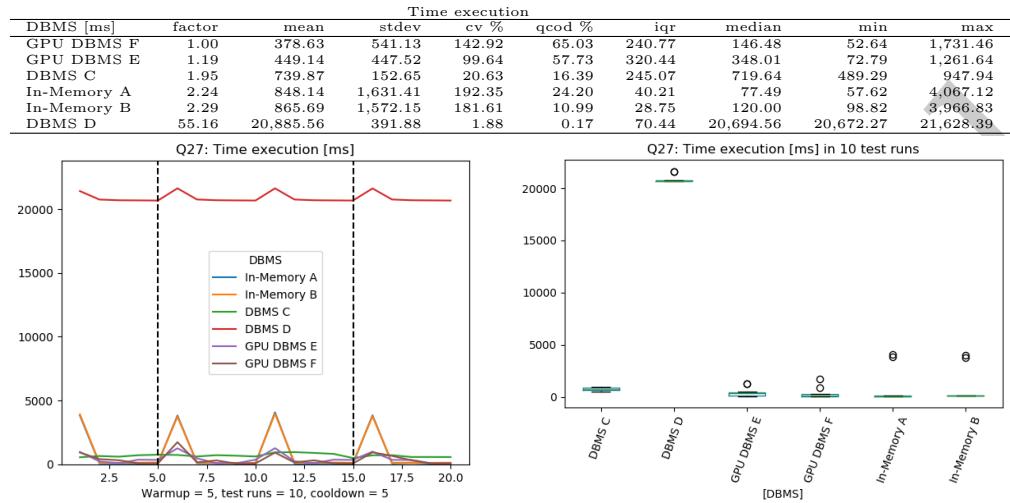


Figure 91: Query 27: Time execution

### 3.24.3 Time datatransfer

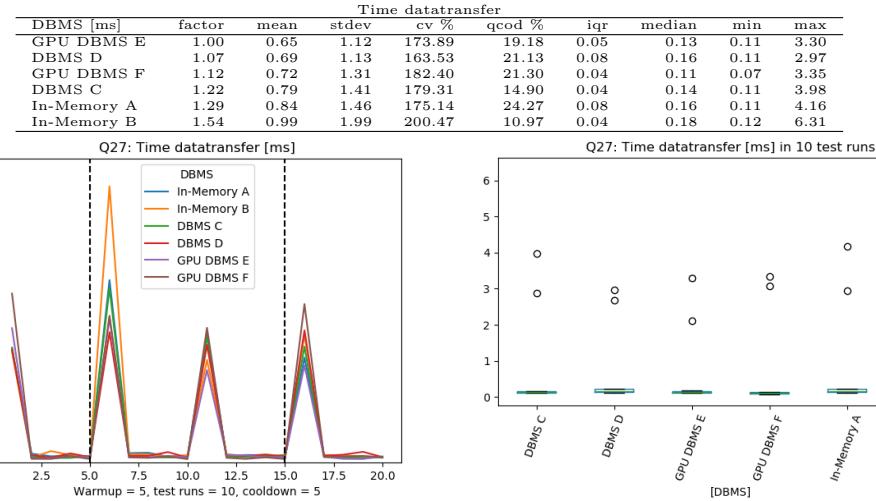


Figure 92: Query 27: Time datatransfer

### 3.24.4 Time connection

Time connection									
DBMS [ms]	factor	mean	stdev	cv %	qcod %	iqr	median	min	max
DBMS D	1.00	522.99	3.99	0.76	0.72	7.57	522.99	519.20	526.77
DBMS C	1.19	624.53	2.64	0.42	0.40	5.01	624.53	622.03	627.04
GPU DBMS E	1.37	717.95	150.77	21.00	19.92	286.06	717.95	574.92	860.98
In-Memory A	1.73	906.68	105.27	11.61	11.02	199.75	906.68	806.81	1,006.55
GPU DBMS F	1.80	943.72	434.84	46.08	43.71	825.05	943.72	531.19	1,356.25
In-Memory B	1.82	950.72	95.58	10.05	9.54	181.34	950.72	860.05	1,041.39

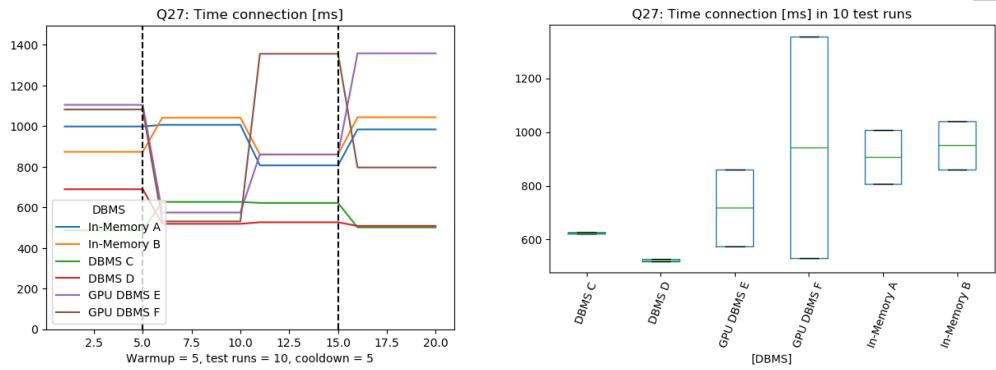


Figure 93: Query 27: Time connection

## 4 Appendix

### 4.1 Survey

#### **Q1: Count rows in nation**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB  
GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB

#### **Q2: Count rows in lineitem**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB  
GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB

#### **Q3: Count rows in orders**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB  
GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB

#### **Q4: Count rows in customer**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB  
GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB

#### **Q5: Count rows in partsupp**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB  
GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB

#### **Q6: Count rows in supplier**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB

GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB

**Q7: Count rows in part**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB

In-Memory B: Received data = 1.7KiB

DBMS C: Received data = 1.7KiB

DBMS D: Received data = 1.7KiB

GPU DBMS E: Received data = 1.7KiB

GPU DBMS F: Received data = 1.7KiB

**Q8: Count rows in region**

Storage size: 96 bytes (result)

In-Memory A: Received data = 1.7KiB

In-Memory B: Received data = 1.7KiB

DBMS C: Received data = 1.7KiB

DBMS D: Received data = 1.7KiB

GPU DBMS E: Received data = 1.7KiB

GPU DBMS F: Received data = 1.7KiB

**Q9: Pricing Summary Report (TPC-H Q1)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 7.8KiB

In-Memory B: Received data = 7.8KiB

DBMS C: Received data = 7.8KiB

DBMS D: Received data = 7.8KiB

GPU DBMS E: Received data = 7.8KiB

GPU DBMS F: Received data = 7.8KiB

**Q10: Minimum Cost Supplier Query (TPC-H Q2)**

inactive

**Q11: Shipping Priority (TPC-H Q3)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 7.0MiB

In-Memory B: Received data = 7.0MiB

DBMS C: Received data = 7.0MiB

DBMS D: Received data = 7.0MiB

GPU DBMS E: Received data = 7.0MiB

GPU DBMS F: Received data = 7.0MiB

**Q12: Order Priority Checking Query (TPC-H Q4)**

inactive

**Q13: Local Supplier Volume (TPC-H Q5)**

Parametrized

Storage size: 2216 bytes (result)

In-Memory A: Received data = 3.1KiB

In-Memory B: Received data = 3.1KiB

DBMS C: Received data = 3.1KiB

DBMS D: Received data = 3.1KiB

GPU DBMS E: Received data = 3.1KiB

GPU DBMS F: Received data = 3.1KiB

**Q14: Forecasting Revenue Change (TPC-H Q6)**

Parametrized

Storage size: 432 bytes (result)

In-Memory A: Received data = 1.7KiB

In-Memory B: Received data = 1.7KiB

DBMS C: Received data = 1.7KiB

DBMS D: Received data = 1.7KiB

GPU DBMS E: Received data = 1.7KiB

GPU DBMS F: Received data = 1.7KiB

**Q15: Forecasting Revenue Change (TPC-H Q7)**

Parametrized

Storage size: 3304 bytes (result)

In-Memory A: Received data = 4.1KiB

In-Memory B: Received data = 4.1KiB

DBMS C: Received data = 4.1KiB

DBMS D: Received data = 4.1KiB

GPU DBMS E: Received data = 4.1KiB

GPU DBMS F: Received data = 4.1KiB

**Q16: National Market Share (TPC-H Q8)**

inactive

**Q17: Product Type Profit Measure (TPC-H Q9)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 83.6KiB

In-Memory B: Received data = 83.6KiB

DBMS C: Received data = 83.6KiB

DBMS D: Received data = 83.6KiB

GPU DBMS E: Received data = 83.6KiB

GPU DBMS F: Received data = 83.6KiB

**Q18: Forecasting Revenue Change (TPC-H Q10)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 26.6KiB

In-Memory B: Received data = 26.6KiB

DBMS C: Received data = 26.6KiB

DBMS D: Received data = 26.6KiB

GPU DBMS E: Received data = 26.6KiB

GPU DBMS F: Received data = 26.6KiB

**Q19: Important Stock Identification (TPC-H Q11)**

Parametrized

Storage size: 432 bytes (size)

In-Memory A: Received data = 295.6KiB

In-Memory B: Received data = 295.6KiB

DBMS C: Received data = 295.6KiB

DBMS D: Received data = 295.6KiB

GPU DBMS E: Received data = 295.6KiB

GPU DBMS F: Received data = 295.6KiB

**Q20: Shipping Modes and Order Priority (TPC-H Q12)**

Parametrized

Storage size: 1672 bytes (result)

In-Memory A: Received data = 2.5KiB

In-Memory B: Received data = 2.5KiB

DBMS C: Received data = 2.5KiB

DBMS D: Received data = 2.5KiB

GPU DBMS E: Received data = 2.5KiB

GPU DBMS F: Received data = 2.5KiB

**Q21: Customer Distribution (TPC-H Q13)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 14.3KiB

In-Memory B: Received data = 14.3KiB

DBMS C: Received data = 14.3KiB

DBMS D: Received data = 14.3KiB

GPU DBMS E: Received data = 14.3KiB

GPU DBMS F: Received data = 14.3KiB

**Q22: Forecasting Revenue Change (TPC-H Q14)**

Parametrized

Storage size: 432 bytes (result)

GPU DBMS E: *numRun 1: : java.sql.SQLException: Query failed : Exception: Overflow or underflow*

GPU DBMS F: *numRun 1: : java.sql.SQLException: Query failed : Exception: Overflow or underflow*

In-Memory A: Received data = 1.7KiB

In-Memory B: Received data = 1.7KiB

DBMS C: Received data = 1.7KiB

DBMS D: Received data = 1.7KiB

**Q23: Top Supplier Query (TPC-H Q15)**

inactive

**Q24: Parts/Supplier Relationship (TPC-H Q16)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 11.2MiB

In-Memory B: Received data = 11.2MiB

DBMS C: Received data = 11.2MiB

DBMS D: Received data = 11.2MiB

GPU DBMS E: Received data = 11.2MiB

GPU DBMS F: Received data = 11.2MiB

**Q25: Small-Quantity-Order Revenue (TPC-H Q17)**

inactive

**Q26: Large Volume Customer (TPC-H Q18)**

Parametrized

Storage size: 432 bytes (hash)

In-Memory A: Received data = 10.2KiB

In-Memory B: Received data = 10.2KiB

DBMS C: Received data = 10.2KiB

DBMS D: Received data = 10.2KiB

GPU DBMS E: Received data = 10.2KiB

GPU DBMS F: Received data = 10.2KiB

**Q27: Discounted Revenue (TPC-H Q19)**

Parametrized

Storage size: 432 bytes (result)

In-Memory A: Received data = 1.7KiB  
In-Memory B: Received data = 1.7KiB  
DBMS C: Received data = 1.7KiB  
DBMS D: Received data = 1.7KiB  
GPU DBMS E: Received data = 1.7KiB  
GPU DBMS F: Received data = 1.7KiB  
**Q28: Potential Part Promotion (TPC-H Q20)**  
inactive  
**Q29: Suppliers Who Kept Orders Waiting Query (TPC-H Q21)**  
inactive  
**Q30: Global Sales Opportunity Query (TPC-H Q22)**  
inactive

## 4.2 Query 1: Count rows in nation

### 4.2.1 Received Data

Result table of run 1:

C
25

### 4.3 Query 2: Count rows in lineitem

#### 4.3.1 Received Data

Result table of run 1:

C
6001215

## 4.4 Query 3: Count rows in orders

### 4.4.1 Received Data

Result table of run 1:

C
1500000

## 4.5 Query 4: Count rows in customer

### 4.5.1 Received Data

Result table of run 1:

C
<u>150000</u>

## 4.6 Query 5: Count rows in partsupp

### 4.6.1 Received Data

Result table of run 1:

C
800000

## 4.7 Query 6: Count rows in supplier

### 4.7.1 Received Data

Result table of run 1:

C
10000

## 4.8 Query 7: Count rows in part

### 4.8.1 Received Data

Result table of run 1:

C
200000

## 4.9 Query 8: Count rows in region

### 4.9.1 Received Data

Result table of run 1:

C
5

## 4.10 Query 9: Pricing Summary Report (TPC-H Q1)

In-Memory A: Different query

```
select
    l_returnflag ,
    l_linenstatus ,
    cast(sum(l_quantity) as unsigned integer) as sum_qty,
    sum(l_extendedprice) as sum_base_price,
    sum(l_extendedprice*(1-l_discount)) as sum_disc_price,
    sum(l_extendedprice*(1-l_discount)*(1+l_tax)) as sum_charge,
    avg(l_quantity) as avg_qty,
    avg(l_extendedprice) as avg_price,
    avg(l_discount) as avg_disc,
    count(*) as count_order
from
    lineitem
where
    l_shipdate <= date('1998-12-01') - interval '{DELTA}' day
group by
    l_returnflag ,
    l_linenstatus
order by
    l_returnflag ,
    l_linenstatus
limit 10000000
```

In-Memory B: Different query

```
select
    l_returnflag ,
    l_linenstatus ,
    cast(sum(l_quantity) as unsigned integer) as sum_qty,
    sum(l_extendedprice) as sum_base_price,
    sum(l_extendedprice*(1-l_discount)) as sum_disc_price,
    sum(l_extendedprice*(1-l_discount)*(1+l_tax)) as sum_charge,
    avg(l_quantity) as avg_qty,
    avg(l_extendedprice) as avg_price,
    avg(l_discount) as avg_disc,
    count(*) as count_order
from
    lineitem
where
    l_shipdate <= date('1998-12-01') - interval '{DELTA}' day
group by
    l_returnflag ,
    l_linenstatus
order by
    l_returnflag ,
    l_linenstatus
limit 10000000
```

#### 4.10.1 Parameter

	DELTA
1	85
2	60
3	83
4	79
5	69
6	87
7	74
8	93
9	98
10	95
11	76
12	66
13	79
14	86
15	93
16	97
17	81
18	76
19	85
20	92

#### 4.10.2 Received Data

**Result hash of run 1:**

hash  
1c1582d9a89feb82991ee2169facb71d39533255221aa09f6eb98bd2

**Result hash of run 2:**

hash  
8639003e10bcad96dc2f34defc8a12fcf502e9a92af617b1e31c0533

**Result hash of run 3:**

hash  
89bcf670975e01c47b02847bb966da2699de155012235b8a03de8f90

**Result hash of run 4:**

hash  
f7d85680921731fc3f28dcf8098e68dfb7a3e87851c51a998eb02877

**Result hash of run 5:**

hash  
ca8a6e05b81a56940991efb55f1dc3b7de6be5e816107e816b1c4c7c

**Result hash of run 6:**

hash  
55cfe3b3b5d776f06d1e3969bdb823580f10b9b906003ac47e61196a

**Result hash of run 7:**

hash  
4056095be0bf5d81cbf4ad4ca74eaadcb652226e2c01eab4c3cfae94

**Result hash of run 8:**

hash  
514003debea54276c635fb31fffc574737fbc20d482c659283d89da

**Result hash of run 9:**

hash  
945d00f44d185d791a49fe06dff72dc7ab9532455f1a1da2472ce7b2

**Result hash of run 10:**

hash  
55c1475ed591a5c87b5c27083040b028c6aa4e6de8656422f3c0cf02

**Result hash of run 11:**

hash  
87a52056a11ca7e6353f5f5788a9c00a25a4822dc3109240b974d724

**Result hash of run 12:**

hash  
02db8240f2f6e809bb506f75351a52928abd771f517639fe804d3efd

**Result hash of run 13:**

hash  
f7d85680921731fc3f28dcf8098e68dfb7a3e87851c51a998eb02877

**Result hash of run 14:**

hash  
891cfb6df80fca218dd69e5674eb9024ab88de69e9529166f81065ef

**Result hash of run 15:** hash  
514003debea54276c635fb31fffc574737fbc20d482c659283d89da

**Result hash of run 16:** hash  
259e38e7dc7940042537c23d579c6a014a2bab0e7e889387c125b82b

**Result hash of run 17:** hash  
259982f9050e6754cff5af0e866bc3982ad1f05277f64d81eed57848

**Result hash of run 18:** hash  
87a52056a11ca7e6353f5f5788a9c00a25a4822dc3109240b974d724

**Result hash of run 19:** hash  
1c1582d9a89feb82991ee2169facb71d39533255221aa09f6eb98bd2

**Result hash of run 20:** hash  
2bbf6fb34658084902e07bdbb33ab2a34ab0fbefa00283f29c8cc760

## 4.11 Query 11: Shipping Priority (TPC-H Q3)

In-Memory A: Different query

```
select
l_orderkey,
sum(l_extendedprice*(1-l_discount)) as revenue,
o_orderdate,
o_shippriority
from
customer,
orders,
lineitem
where
c_mktsegment = '{SEGMENT}'
and c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate < date('{DATE}')
and l_shipdate > date('{DATE}')
group by
l_orderkey,
o_orderdate,
o_shippriority
order by
revenue desc,
o_orderdate
limit 10000000
```

In-Memory B: Different query

```
select
l_orderkey,
sum(l_extendedprice*(1-l_discount)) as revenue,
o_orderdate,
o_shippriority
from
customer,
orders,
lineitem
where
c_mktsegment = '{SEGMENT}'
and c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate < date('{DATE}')
and l_shipdate > date('{DATE}')
group by
l_orderkey,
o_orderdate,
o_shippriority
order by
revenue desc,
o_orderdate
limit 10000000
```

#### 4.11.1 Parameter

	DATE	SEGMENT
1	1995-03-08	MACHINERY
2	1995-03-26	MACHINERY
3	1995-03-26	BUILDING
4	1995-03-26	MACHINERY
5	1995-03-02	MACHINERY
6	1995-03-06	HOUSEHOLD
7	1995-03-20	BUILDING
8	1995-03-25	MACHINERY
9	1995-03-16	FURNITURE
10	1995-03-06	AUTOMOBILE
11	1995-03-03	AUTOMOBILE
12	1995-03-08	HOUSEHOLD
13	1995-03-23	BUILDING
14	1995-03-20	HOUSEHOLD
15	1995-03-08	MACHINERY
16	1995-03-04	AUTOMOBILE
17	1995-03-15	FURNITURE
18	1995-03-08	MACHINERY
19	1995-03-15	MACHINERY
20	1995-03-05	BUILDING

#### 4.11.2 Received Data

**Result hash of run 1:**

hash

0a0d56606fc6af1bbd83affbb3ea0060c91e0b7e8b0e221506ce2a265

**Result hash of run 2:**

hash

f937837a3a586e120bed4fa75b5f1b0cabcb81d06672a91679d17ee0

**Result hash of run 3:**

hash

cc5ce83d32ae9d8773b8b25c891b7721929074b1fb0c9410d8777c42

**Result hash of run 4:**

hash

f937837a3a586e120bed4fa75b5f1b0cabcb81d06672a91679d17ee0

**Result hash of run 5:**

hash

fb5c4bed8955539f13aa38d7431190ab0eb3dec8b93d515b78d8c24a

**Result hash of run 6:**

hash

d66e785616b8916c0b91a7b198ad025e73eeaa41fa505d3ccdd54d90

**Result hash of run 7:**

hash

05840bb0f6e621e0284177178f78bc95c66e8b825148db4b17203e5a

**Result hash of run 8:**

hash

371a006f14501a5534feeee16e37e5ddbd03dc136232c333fce1d78

**Result hash of run 9:**

hash

2e0a752e049f2c3ff4abb8b8e100956d06c431ee179356554143dfce

**Result hash of run 10:**

hash

1e6d4b4967dd2dd5dfbc619c17fc09663ada4ec11a7b6d22dff83c93

**Result hash of run 11:**

hash

b2870e09123b0a8d15f1a4a10f1ecf0dc97f97d339b8f5fa511b71d6

**Result hash of run 12:**

hash

96c1077ffaf5bbd448a638874fcb9a487aa1869b0028fedaadc83ee2

**Result hash of run 13:**

hash

9eb899cb609152866053d266c995f9e2e07891baaf33bc30f980b1f3

**Result hash of run 14:**

hash

0fbda4d3de1e3843c83dde8de66d927bbec299668d3a144465e50af62

**Result hash of run 15:** hash  
0a0d56606fc6af1bbd83afbb3ea0060c91e0b7e8b0e221506ce2a265

**Result hash of run 16:** hash  
b3b777a17a14530a5cd785147311e737ca49f8eb10c2141c169f7df2

**Result hash of run 17:** hash  
43dee644ed99a92d4c8ff15878573266d3e201f8b8c70c9384b31686

**Result hash of run 18:** hash  
0a0d56606fc6af1bbd83afbb3ea0060c91e0b7e8b0e221506ce2a265

**Result hash of run 19:** hash  
b94d351ff98f3511c083e601e9bcfd7d70023339de1f49590be9f9e6

**Result hash of run 20:** hash  
c7d82b41f53fbadd9f672053a432b0ae75f3db35eff819420d84a2e9

## 4.12 Query 13: Local Supplier Volume (TPC-H Q5)

In-Memory A: Different query

```
select
n_name,
sum(l_extendedprice * (1 - l_discount)) as revenue
from
customer,
orders,
lineitem,
supplier,
nation,
region
where
c_custkey = o_custkey
and l_orderkey = o_orderkey
and l_suppkey = s_suppkey
and c_nationkey = s_nationkey
and s_nationkey = n_nationkey
and n_regionkey = r_regionkey
and r_name = '{REGION}'
and o_orderdate >= date('{DATE}')
and o_orderdate < date('{DATE}') + interval '1' year
group by
n_name
order by
revenue desc
limit 10000000
```

In-Memory B: Different query

```
select
n_name,
sum(l_extendedprice * (1 - l_discount)) as revenue
from
customer,
orders,
lineitem,
supplier,
nation,
region
where
c_custkey = o_custkey
and l_orderkey = o_orderkey
and l_suppkey = s_suppkey
and c_nationkey = s_nationkey
and s_nationkey = n_nationkey
and n_regionkey = r_regionkey
and r_name = '{REGION}'
and o_orderdate >= date('{DATE}')
and o_orderdate < date('{DATE}') + interval '1' year
group by
n_name
order by
revenue desc
limit 10000000
```

#### 4.12.1 Parameter

	DATE	REGION
1	1993-01-01	ASIA
2	1994-01-01	AMERICA
3	1996-01-01	AMERICA
4	1996-01-01	MIDDLE EAST
5	1996-01-01	AMERICA
6	1995-01-01	ASIA
7	1995-01-01	AMERICA
8	1995-01-01	MIDDLE EAST
9	1993-01-01	EUROPE
10	1996-01-01	AFRICA
11	1994-01-01	MIDDLE EAST
12	1994-01-01	EUROPE
13	1997-01-01	AFRICA
14	1997-01-01	AFRICA
15	1993-01-01	AFRICA
16	1996-01-01	MIDDLE EAST
17	1997-01-01	EUROPE
18	1997-01-01	AFRICA
19	1997-01-01	AMERICA
20	1997-01-01	ASIA

#### 4.12.2 Received Data

##### Result table of run 1:

N_NAME	REVENUE
CHINA	52,189,752.0728
INDIA	53,795,671.1001
INDONESIA	52,965,538.9463
JAPAN	48,790,265.1227
VIETNAM	53,966,100.4614

##### Result table of run 2:

N_NAME	REVENUE
ARGENTINA	54,595,012.8076
BRAZIL	53,601,776.5201
CANADA	56,052,846.0161
PERU	56,206,762.5035
UNITED STATES	50,890,580.8962

##### Result table of run 3:

N_NAME	REVENUE
ARGENTINA	55,124,047.4336
BRAZIL	52,775,926.0750
CANADA	53,670,254.9230
PERU	54,684,525.5116
UNITED STATES	52,523,919.6379

##### Result table of run 4:

N_NAME	REVENUE
EGYPT	56,285,121.7070
IRAN	49,857,338.9334
IRAQ	60,149,107.3081
JORDAN	50,544,952.1150
SAUDI ARABIA	53,014,601.7633

##### Result table of run 5:

N_NAME	REVENUE
ARGENTINA	55,124,047.4336
BRAZIL	52,775,926.0750
CANADA	53,670,254.9230
PERU	54,684,525.5116
UNITED STATES	52,523,919.6379

##### Result table of run 6:

N_NAME	REVENUE
CHINA	53,387,587.3489
INDIA	55,705,718.6713
INDONESIA	56,733,283.8716
JAPAN	48,481,534.4057
VIETNAM	51,634,352.6202

##### Result table of run 7:

N_NAME	REVENUE
ARGENTINA	52,784,554.0414
BRAZIL	51,810,480.5982
CANADA	57,024,368.2378
PERU	55,654,679.8789
UNITED STATES	51,076,207.2022

**Result table of run 8:**

N_NAME	REVENUE
EGYPT	53,534,848.8262
IRAN	50,867,712.4702
IRAQ	55,613,560.4794
JORDAN	48,588,461.4921
SAUDI ARABIA	53,455,219.9390

**Result table of run 9:**

N_NAME	REVENUE
FRANCE	54,436,355.2609
GERMANY	53,161,745.6445
ROMANIA	52,712,944.0034
RUSSIA	56,715,418.5622
UNITED KINGDOM	52,569,055.9493

**Result table of run 10:**

N_NAME	REVENUE
ALGERIA	53,591,119.0055
ETHIOPIA	50,195,161.7541
KENYA	45,423,425.6432
MOROCCO	49,685,481.2805
MOZAMBIQUE	57,836,194.6976

**Result table of run 11:**

N_NAME	REVENUE
EGYPT	53,293,463.6888
IRAN	50,487,778.1438
IRAQ	58,232,553.2776
JORDAN	48,801,457.3985
SAUDI ARABIA	53,335,013.3675

**Result table of run 12:**

N_NAME	REVENUE
FRANCE	52,373,887.2775
GERMANY	49,641,771.6966
ROMANIA	52,284,640.4995
RUSSIA	57,015,542.6869
UNITED KINGDOM	52,279,329.9720

**Result table of run 13:**

N_NAME	REVENUE
ALGERIA	55,579,002.6347
ETHIOPIA	49,327,831.7214
KENYA	45,538,187.4775
MOROCCO	46,813,540.6771
MOZAMBIQUE	56,212,522.6300

**Result table of run 14:**

N_NAME	REVENUE
ALGERIA	55,579,002.6347
ETHIOPIA	49,327,831.7214
KENYA	45,538,187.4775
MOROCCO	46,813,540.6771
MOZAMBIQUE	56,212,522.6300

**Result table of run 15:**

N_NAME	REVENUE
ALGERIA	53,712,346.4652
ETHIOPIA	52,353,884.4356
KENYA	48,330,222.5607
MOROCCO	49,958,146.4192
MOZAMBIQUE	56,599,200.5922

**Result table of run 16:**

N_NAME	REVENUE
EGYPT	56,285,121.7070
IRAN	49,857,338.9334
IRAQ	60,149,107.3081
JORDAN	50,544,952.1150
SAUDI ARABIA	53,014,601.7633

**Result table of run 17:**

N_NAME	REVENUE
FRANCE	51,802,583.9609
GERMANY	51,835,934.6849
ROMANIA	54,833,355.4104
RUSSIA	53,818,222.3562
UNITED KINGDOM	49,107,998.3846

**Result table of run 18:**

N_NAME	REVENUE
ALGERIA	55,579,002.6347
ETHIOPIA	49,327,831.7214
KENYA	45,538,187.4775
MOROCCO	46,813,540.6771
MOZAMBIQUE	56,212,522.6300

**Result table of run 19:**

N_NAME	REVENUE
ARGENTINA	55,213,294.4745
BRAZIL	53,012,529.2573
CANADA	57,165,000.3824
PERU	51,767,803.7854
UNITED STATES	53,893,948.9531

**Result table of run 20:**

N_NAME	REVENUE
CHINA	50,163,777.4720
INDIA	54,044,397.1012
INDONESIA	58,291,001.0156
JAPAN	50,211,875.7932
VIETNAM	53,239,489.8272

## 4.13 Query 14: Forecasting Revenue Change (TPC-H Q6)

In-Memory A: Different query

```
select
sum(l_extendedprice*l_discount) as revenue
from
lineitem
where
l_shipdate >= date('{DATE}')
and l_shipdate < date('{DATE}') + interval '1' year
and l_discount between {DISCOUNT} - 0.01 and {DISCOUNT} + 0.01
and l_quantity < {QUANTITY}
limit 10000000
```

In-Memory B: Different query

```
select
sum(l_extendedprice*l_discount) as revenue
from
lineitem
where
l_shipdate >= date('{DATE}')
and l_shipdate < date('{DATE}') + interval '1' year
and l_discount between {DISCOUNT} - 0.01 and {DISCOUNT} + 0.01
and l_quantity < {QUANTITY}
limit 10000000
```

### 4.13.1 Parameter

	DATE	DISCOUNT	QUANTITY
1	1993-01-01	0.879834	24
2	1993-01-01	0.266277	24
3	1997-01-01	0.985074	25
4	1997-01-01	0.350402	25
5	1996-01-01	0.237223	25
6	1994-01-01	0.284308	24
7	1993-01-01	0.590542	25
8	1994-01-01	0.798071	25
9	1993-01-01	0.688948	24
10	1993-01-01	0.82131	25
11	1994-01-01	0.956778	24
12	1995-01-01	1.06947	24
13	1993-01-01	0.354933	25
14	1993-01-01	0.223284	24
15	1995-01-01	0.0688913	25
16	1994-01-01	0.512698	25
17	1995-01-01	0.265601	24
18	1996-01-01	0.108401	24
19	1996-01-01	0.093132	24
20	1994-01-01	0.87291	24

### 4.13.2 Received Data

**Result table of run 1:**  
REVENUE  
None

**Result table of run 2:**  
REVENUE  
None

**Result table of run 3:**  
REVENUE  
None

**Result table of run 4:**  
REVENUE  
None

**Result table of run 5:**  
REVENUE  
None

**Result table of run 6:**  
REVENUE  
None

**Result table of run 7:**  
REVENUE  
None

**Result table of run 8:**  
REVENUE  
None

**Result table of run 9:**  
REVENUE  
None

**Result table of run 10:**  
REVENUE  
None

**Result table of run 11:**  
REVENUE  
None

**Result table of run 12:**  
REVENUE  
None

**Result table of run 13:**  
REVENUE  
None

**Result table of run 14:**  
REVENUE  
None

**Result table of run 15:**  
REVENUE  
96,953,273.6248

**Result table of run 16:**  
REVENUE  
None

**Result table of run 17:**  
REVENUE  
None

**Result table of run 18:**  
REVENUE  
68,634,150.9330

**Result table of run 19:**  
REVENUE  
130,908,284.4198

**Result table of run 20:**  
REVENUE  
None

## 4.14 Query 15: Forecasting Revenue Change (TPC-H Q7)

In-Memory A: Different query

```
select
supp_nation,
cust_nation,
l_year , sum(volume) as revenue
from (
select
n1.n_name as supp_nation,
n2.n_name as cust_nation,
extract(year from l_shipdate) as l_year,
l_extendedprice * (1 - l_discount) as volume
from
supplier,
lineitem,
orders,
customer,
nation n1,
nation n2
where
s_suppkey = l_suppkey
and o_orderkey = l_orderkey
and c_custkey = o_custkey
and s_nationkey = n1.n_nationkey
and c_nationkey = n2.n_nationkey
and (
(n1.n_name = '{NATION1}' and n2.n_name = '{NATION2}')
or (n1.n_name = '{NATION2}' and n2.n_name = '{NATION1}')
)
and l_shipdate between date('1995-01-01') and date('1996-12-31')
) as shipping
group by
supp_nation,
cust_nation,
l_year
order by
supp_nation,
cust_nation,
l_year
limit 10000000
```

In-Memory B: Different query

```
select
supp_nation,
cust_nation,
l_year , sum(volume) as revenue
from (
select
n1.n_name as supp_nation,
n2.n_name as cust_nation,
extract(year from l_shipdate) as l_year,
l_extendedprice * (1 - l_discount) as volume
from
supplier,
lineitem,
orders,
customer,
nation n1,
nation n2
where
```

```

s_suppkey = l_suppkey
and o_orderkey = l_orderkey
and c_custkey = o_custkey
and s_nationkey = n1.n_nationkey
and c_nationkey = n2.n_nationkey
and (
(n1.n_name = '{NATION1}' and n2.n_name = '{NATION2}')
or (n1.n_name = '{NATION2}' and n2.n_name = '{NATION1}')
)
and l_shipdate between date('1995-01-01') and date('1996-12-31')
) as shipping
group by
supp_nation,
cust_nation,
l_year
order by
supp_nation,
cust_nation,
l_year
limit 10000000

```

#### 4.14.1 Parameter

	NATION1	NATION2
1	FRANCE	KENYA
2	ROMANIA	IRAQ
3	RUSSIA	UNITED KINGDOM
4	GERMANY	FRANCE
5	EGYPT	IRAQ
6	UNITED STATES	FRANCE
7	RUSSIA	JORDAN
8	INDIA	KENYA
9	VIETNAM	UNITED STATES
10	BRAZIL	CHINA
11	RUSSIA	BRAZIL
12	FRANCE	KENYA
13	IRAQ	ALGERIA
14	CHINA	ARGENTINA
15	IRAQ	INDIA
16	ETHIOPIA	MOZAMBIQUE
17	VIETNAM	CANADA
18	JORDAN	CHINA
19	VIETNAM	SAUDI ARABIA
20	VIETNAM	EGYPT

#### 4.14.2 Received Data

##### Result table of run 1:

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
FRANCE	KENYA	1995	51,525,420.5062
FRANCE	KENYA	1996	52,496,931.9629
KENYA	FRANCE	1995	51,839,569.5339
KENYA	FRANCE	1996	50,533,734.5138

##### Result table of run 2:

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
IRAQ	ROMANIA	1995	59,072,391.0968
IRAQ	ROMANIA	1996	59,748,603.7901
ROMANIA	IRAQ	1995	51,384,339.1586
ROMANIA	IRAQ	1996	53,550,315.6531

##### Result table of run 3:

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
RUSSIA	UNITED KINGDOM	1995	50,586,201.1765
RUSSIA	UNITED KINGDOM	1996	52,005,808.0204
UNITED KINGDOM	RUSSIA	1995	50,255,652.2120
UNITED KINGDOM	RUSSIA	1996	50,917,377.6712

##### Result table of run 4:

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
FRANCE	GERMANY	1995	54,639,732.7336
FRANCE	GERMANY	1996	54,633,083.3076
GERMANY	FRANCE	1995	52,531,746.6697
GERMANY	FRANCE	1996	52,520,549.0224

**Result table of run 5:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
EGYPT	IRAQ	1995	54,006,215.2053
EGYPT	IRAQ	1996	54,326,949.0012
IRAQ	EGYPT	1995	58,306,083.4308
IRAQ	EGYPT	1996	56,656,796.0146

**Result table of run 6:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
FRANCE	UNITED STATES	1995	51,745,265.8021
FRANCE	UNITED STATES	1996	52,180,715.6332
UNITED STATES	FRANCE	1995	51,947,695.1671
UNITED STATES	FRANCE	1996	51,215,278.0730

**Result table of run 7:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
JORDAN	RUSSIA	1995	49,411,751.4480
JORDAN	RUSSIA	1996	50,441,431.1052
RUSSIA	JORDAN	1995	52,389,774.8731
RUSSIA	JORDAN	1996	55,326,281.8242

**Result table of run 8:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
INDIA	KENYA	1995	55,011,076.5963
INDIA	KENYA	1996	52,770,843.2872
KENYA	INDIA	1995	51,003,568.0982
KENYA	INDIA	1996	51,883,771.6024

**Result table of run 9:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
UNITED STATES	VIETNAM	1995	52,789,091.8774
UNITED STATES	VIETNAM	1996	55,316,705.1613
VIETNAM	UNITED STATES	1995	56,591,957.9905
VIETNAM	UNITED STATES	1996	54,788,532.4442

**Result table of run 10:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
BRAZIL	CHINA	1995	53,158,930.8962
BRAZIL	CHINA	1996	53,445,989.5439
CHINA	BRAZIL	1995	50,181,410.9924
CHINA	BRAZIL	1996	51,657,396.6330

**Result table of run 11:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
BRAZIL	RUSSIA	1995	53,982,590.6094
BRAZIL	RUSSIA	1996	55,233,459.7627
RUSSIA	BRAZIL	1995	54,719,981.1707
RUSSIA	BRAZIL	1996	52,359,461.2246

**Result table of run 12:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
FRANCE	KENYA	1995	51,525,420.5062
FRANCE	KENYA	1996	52,496,931.9629
KENYA	FRANCE	1995	51,839,569.5339
KENYA	FRANCE	1996	50,533,734.5138

**Result table of run 13:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
ALGERIA	IRAQ	1995	51,496,599.8679
ALGERIA	IRAQ	1996	56,992,712.6975
IRAQ	ALGERIA	1995	57,197,963.7538
IRAQ	ALGERIA	1996	55,823,882.9147

**Result table of run 14:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
ARGENTINA	CHINA	1995	54,800,400.1583
ARGENTINA	CHINA	1996	58,755,945.6719
CHINA	ARGENTINA	1995	53,494,062.1458
CHINA	ARGENTINA	1996	54,024,419.3704

**Result table of run 15:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
INDIA	IRAQ	1995	51,544,090.1809
INDIA	IRAQ	1996	52,471,788.4177
IRAQ	INDIA	1995	59,053,892.6535
IRAQ	INDIA	1996	54,618,565.6772

**Result table of run 16:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
ETHIOPIA	MOZAMBIQUE	1995	47,912,354.6948
ETHIOPIA	MOZAMBIQUE	1996	48,725,872.0260
MOZAMBIQUE	ETHIOPIA	1995	56,164,990.2532
MOZAMBIQUE	ETHIOPIA	1996	53,498,610.6875

**Result table of run 17:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
CANADA	VIETNAM	1995	53,701,668.7098
CANADA	VIETNAM	1996	53,879,121.1980
VIETNAM	CANADA	1995	52,963,568.6931
VIETNAM	CANADA	1996	54,185,021.9763

**Result table of run 18:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
CHINA	JORDAN	1995	55,540,508.7877
CHINA	JORDAN	1996	59,759,729.2877
JORDAN	CHINA	1995	48,662,796.1206
JORDAN	CHINA	1996	47,259,863.8697

**Result table of run 19:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
SAUDI ARABIA	VIETNAM	1995	56,133,539.0270
SAUDI ARABIA	VIETNAM	1996	58,318,903.9455
VIETNAM	SAUDI ARABIA	1995	52,062,285.8966
VIETNAM	SAUDI ARABIA	1996	50,976,881.0878

**Result table of run 20:**

SUPP_NATION	CUST_NATION	L_YEAR	REVENUE
EGYPT	VIETNAM	1995	54,181,675.9324
EGYPT	VIETNAM	1996	56,663,542.6970
VIETNAM	EGYPT	1995	52,923,855.7377
VIETNAM	EGYPT	1996	52,911,069.2932

## 4.15 Query 17: Product Type Profit Measure (TPC-H Q9)

In-Memory A: Different query

```
select
nation,
o_year,
sum(amount) as sum_profit
from (
select
n_name as nation,
extract(year from o_orderdate) as o_year,
l_extendedprice * (1 - l_discount) - ps_supplycost * l_quantity as amount
from
part,
supplier,
lineitem,
partsupp,
orders,
nation
where
s_suppkey = l_suppkey
and ps_suppkey = l_suppkey
and ps_partkey = l_partkey
and p_partkey = l_partkey
and o_orderkey = l_orderkey
and s_nationkey = n_nationkey
and p_name like '%{COLOR}%' )
as profit
group by
nation,
o_year
order by
nation,
o_year desc
limit 10000000
```

In-Memory B: Different query

```
select
nation,
o_year,
sum(amount) as sum_profit
from (
select
n_name as nation,
extract(year from o_orderdate) as o_year,
l_extendedprice * (1 - l_discount) - ps_supplycost * l_quantity as amount
from
part,
supplier,
lineitem,
partsupp,
orders,
nation
where
s_suppkey = l_suppkey
and ps_suppkey = l_suppkey
and ps_partkey = l_partkey
and p_partkey = l_partkey
and o_orderkey = l_orderkey
and s_nationkey = n_nationkey
```

```

and p_name like '%{COLOR}%'  

) as profit  

group by  

nation,  

o_year  

order by  

nation,  

o_year desc  

limit 10000000

```

#### 4.15.1 Parameter

	COLOR
1	metallic
2	dark
3	burlywood
4	gainsboro
5	orchid
6	ghost
7	lace
8	lemon
9	purple
10	sandy
11	firebrick
12	black
13	bisque
14	slate
15	blue
16	navajo
17	yellow
18	metallic
19	coral
20	orchid

#### 4.15.2 Received Data

**Result hash of run 1:**

hash
b141982628644e11204feafeb89092780bf31a81421cc000bcf1c4e1

**Result hash of run 2:**

hash
a3bcd7b39c904b3a3859b635d0d9ca795f5c8c8f979fd8a7452258f3

**Result hash of run 3:**

hash
1c6a5ef2cbfd34267cef5a2a0ed736e7e4ff2c2e3ce09295703b7db5

**Result hash of run 4:**

hash
92b2c636b0eb5e5898fc8eb84c1b9323a9585b98eaf7ea8e3e110154

**Result hash of run 5:**

hash
584271e86430e1bdebcd10c13a10af123af6d37a203ebdf6343a3b72

**Result hash of run 6:**

hash
459f3bbf12f91188cbde6ea22455e77759a2aaceda93c8cdd6e37688

**Result hash of run 7:**

hash
250bc294a029d84366fa6830521f57e56c563a4bc3213030372bb095

**Result hash of run 8:**

hash
ed14abe24abd29f9f875c23559f6203fd81859af20c79fad3e386d94

**Result hash of run 9:**

hash
53206a4aa5ecdba1b77fc0fd92ced71ec49dc0b6aadd1ce79d7f0ac6

**Result hash of run 10:**

hash
0a048416421559bdc283ebd201b8d539d4c96876bb0666839a4c9ae1

**Result hash of run 11:** hash  
fd55976e071acf8e98ea8bf4954bd7d770672fda1985b3d6139433e

**Result hash of run 12:** hash  
334c25f9bb4f9f451dd10b37ebd8110430ee6d27e38c1a24b0144912

**Result hash of run 13:** hash  
d35903ef48d6558e9c31ab7392deeeb19d9fe6b1135df5367584d6ba

**Result hash of run 14:** hash  
1ab2c752beb5c494cfdf7b30eade4c2c2092fd1d49810142a95edd47

**Result hash of run 15:** hash  
4c169b67b741f62f9bd15599f1f6b9ddb85dda2917f0f44b7e4206bb

**Result hash of run 16:** hash  
15fd7a9adb9546745fcf18050739b5af3cee5560ed3b9d88d347c7f1

**Result hash of run 17:** hash  
2fa6f15e9a5e5f4a0a5f6bc9d52f5be280cea20c3cebf28fde98f37d

**Result hash of run 18:** hash  
b141982628644e11204feafeb89092780bf31a81421cc000bcf1c4e1

**Result hash of run 19:** hash  
1472b178aeddf8a4cf83324d579b9b28e65a020b0164bd501d91ab29

**Result hash of run 20:** hash  
584271e86430e1bdebcd10c13a10af123af6d37a203ebdf6343a3b72

## 4.16 Query 18: Forecasting Revenue Change (TPC-H Q10)

In-Memory A: Different query

```
select
c_custkey,
c_name,
sum(l_extendedprice * (1 - l_discount)) as revenue,
c_acctbal,
n_name,
c_address,
c_phone,
c_comment
from
customer,
orders,
lineitem,
nation
where
c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate >= date('{DATE}')
and o_orderdate < date('{DATE}') + interval '3' month
and l_returnflag = 'R'
and c_nationkey = n_nationkey
group by
c_custkey,
c_name,
c_acctbal,
c_phone,
n_name,
c_address,
c_comment
order by
revenue desc
limit 20
```

In-Memory B: Different query

```
select
c_custkey,
c_name,
sum(l_extendedprice * (1 - l_discount)) as revenue,
c_acctbal,
n_name,
c_address,
c_phone,
c_comment
from
customer,
orders,
lineitem,
nation
where
c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate >= date('{DATE}')
and o_orderdate < date('{DATE}') + interval '3' month
and l_returnflag = 'R'
and c_nationkey = n_nationkey
group by
c_custkey,
c_name,
```

```

c_acctbal,
c_phone,
n_name,
c_address,
c_comment
order by
revenue desc
limit 20

```

#### 4.16.1 Parameter

	DATE
1	1995-01-01
2	1993-11-01
3	1994-09-01
4	1994-07-01
5	1994-10-01
6	1993-05-01
7	1993-05-01
8	1993-07-01
9	1994-02-01
10	1994-01-01
11	1993-07-01
12	1994-07-01
13	1994-07-01
14	1994-01-01
15	1994-07-01
16	1993-05-01
17	1993-12-01
18	1994-09-01
19	1993-11-01
20	1993-09-01

#### 4.16.2 Received Data

**Result hash of run 1:**

hash
ef5f8028e06bf2cdf4b25f4fc71459e5ae9a82218d18b05fccd4799d

**Result hash of run 2:**

hash
a266293ae64a91957f82d081556eb22419978a0c882c4843838f4243

**Result hash of run 3:**

hash
8283ee024bd054cfca9dac4967b4bc4ca8e56f24fdb862a4c93a1ade4

**Result hash of run 4:**

hash
89524c916089f747e52a4496078aa7cbb9ffd77d2fe7a3b9b355c3a1

**Result hash of run 5:**

hash
246a355ff389760e8d40c0d1ce367df329bf63fabff3bbe383b9dea7

**Result hash of run 6:**

hash
1fce4b101801d634199125bcad872cf28ebc12850422fb3b2617691b

**Result hash of run 7:**

hash
1fce4b101801d634199125bcad872cf28ebc12850422fb3b2617691b

**Result hash of run 8:**

hash
83b0ffcff10f64702e27acd889b7b3c42a304c520841ac86eeb30e86

**Result hash of run 9:**

hash
2ea7db3fb1a04e9c986e2b54060340ec8d340ae13a88d978c6ed2254

**Result hash of run 10:**

hash
dc31de98aa004b223536988de622a9594b48e69af4c1a02399ff4e49

**Result hash of run 11:**

hash  
83b0ffcff10f64702e27acd889b7b3c42a304c520841ac86eeb30e86

**Result hash of run 12:**

hash  
89524c916089f747e52a4496078aa7cbb9ffd77d2fe7a3b9b355c3a1

**Result hash of run 13:**

hash  
89524c916089f747e52a4496078aa7cbb9ffd77d2fe7a3b9b355c3a1

**Result hash of run 14:**

hash  
dc31de98aa004b223536988de622a9594b48e69af4c1a02399ff4e49

**Result hash of run 15:**

hash  
89524c916089f747e52a4496078aa7cbb9ffd77d2fe7a3b9b355c3a1

**Result hash of run 16:**

hash  
1cfe4b101801d634199125bcad872cf28ebc12850422fb3b2617691b

**Result hash of run 17:**

hash  
97b87dad30120e61ef4b75640c32d4600b091922be189eb66a7131c6

**Result hash of run 18:**

hash  
8283ee024bd054fcf9dac4967b4bc4ca8e56f24fdb862a4c93a1ade4

**Result hash of run 19:**

hash  
a266293ae64a91957f82d081556eb22419978a0c882c4843838f4243

**Result hash of run 20:**

hash  
112df53810840c363dc5119b582ce76564a999c81dd3f230b85ddfa6

## 4.17 Query 19: Important Stock Identification (TPC-H Q11)

### 4.17.1 Parameter

	FRACTION	NATION
1	0.0001	UNITED STATES
2	0.0001	PERU
3	0.0001	JORDAN
4	0.0001	ARGENTINA
5	0.0001	ARGENTINA
6	0.0001	ALGERIA
7	0.0001	SAUDI ARABIA
8	0.0001	GERMANY
9	0.0001	ROMANIA
10	0.0001	IRAN
11	0.0001	CHINA
12	0.0001	MOROCCO
13	0.0001	FRANCE
14	0.0001	ROMANIA
15	0.0001	CANADA
16	0.0001	INDONESIA
17	0.0001	CANADA
18	0.0001	UNITED STATES
19	0.0001	EGYPT
20	0.0001	KENYA

### 4.17.2 Received Data

**Result size of run 1:**  
size  
16576

**Result size of run 2:**  
size  
11936

**Result size of run 3:**  
size  
23584

**Result size of run 4:**  
size  
12656

**Result size of run 5:**  
size  
12656

**Result size of run 6:**  
size  
10720

**Result size of run 7:**  
size  
13504

**Result size of run 8:**  
size  
16848

**Result size of run 9:**  
size  
14880

**Result size of run 10:**  
size  
17072

**Result size of run 11:**  
size  
13984

**Result size of run 12:**  
size  
20704

**Result size of run 13:**  
size  
14656

**Result size of run 14:**

size  
14880

**Result size of run 15:**

size  
13184

**Result size of run 16:**

size  
14288

**Result size of run 17:**

size  
13184

**Result size of run 18:**

size  
16576

**Result size of run 19:**

size  
11264

**Result size of run 20:**

size  
19552

## 4.18 Query 20: Shipping Modes and Order Priority (TPC-H Q12)

In-Memory A: Different query

```
select
l_shipmode,
sum(case
when o_orderpriority ='1-URGENT'
or o_orderpriority ='2-HIGH'
then 1.0
else 0.0
end) as high_line_count,
sum(case
when o_orderpriority <> '1-URGENT'
and o_orderpriority <> '2-HIGH'
then 1.0
else 0.0
end) as low_line_count
from
orders,
lineitem
where
o_orderkey = l_orderkey
and l_shipmode in ('{SHIPMODE1}', '{SHIPMODE2}')
and l_commitdate < l_receiptdate
and l_shipdate < l_commitdate
and l_receiptdate >= date('{DATE}')
and l_receiptdate < date('{DATE}') + interval '1' year
group by
l_shipmode
order by
l_shipmode
limit 10000000
```

In-Memory B: Different query

```
select
l_shipmode,
sum(case
when o_orderpriority ='1-URGENT'
or o_orderpriority ='2-HIGH'
then 1.0
else 0.0
end) as high_line_count,
sum(case
when o_orderpriority <> '1-URGENT'
and o_orderpriority <> '2-HIGH'
then 1.0
else 0.0
end) as low_line_count
from
orders,
lineitem
where
o_orderkey = l_orderkey
and l_shipmode in ('{SHIPMODE1}', '{SHIPMODE2}')
and l_commitdate < l_receiptdate
and l_shipdate < l_commitdate
and l_receiptdate >= date('{DATE}')
and l_receiptdate < date('{DATE}') + interval '1' year
group by
l_shipmode
```

```

order by
l_shipmode
limit 10000000

```

#### 4.18.1 Parameter

	DATE	SHIPMODE1	SHIPMODE2
1	1997-01-01	AIR	TRUCK
2	1997-01-01	FOB	RAIL
3	1996-01-01	TRUCK	MAIL
4	1995-01-01	TRUCK	SHIP
5	1995-01-01	AIR	FOB
6	1993-01-01	SHIP	REG AIR
7	1995-01-01	RAIL	FOB
8	1997-01-01	AIR	RAIL
9	1994-01-01	AIR	RAIL
10	1995-01-01	SHIP	MAIL
11	1994-01-01	AIR	SHIP
12	1994-01-01	FOB	AIR
13	1994-01-01	TRUCK	REG AIR
14	1994-01-01	REG AIR	MAIL
15	1996-01-01	SHIP	FOB
16	1995-01-01	MAIL	RAIL
17	1994-01-01	MAIL	FOB
18	1996-01-01	REG AIR	MAIL
19	1994-01-01	MAIL	TRUCK
20	1993-01-01	TRUCK	MAIL

#### 4.18.2 Received Data

##### Result table of run 1:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
AIR	6,290.0000	9,263.0000
TRUCK	6,123.0000	9,365.0000

##### Result table of run 2:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
FOB	6,335.0000	9,242.0000
RAIL	6,365.0000	9,340.0000

##### Result table of run 3:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,252.0000	9,376.0000
TRUCK	6,336.0000	9,300.0000

##### Result table of run 4:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
SHIP	6,266.0000	9,251.0000
TRUCK	6,284.0000	9,444.0000

##### Result table of run 5:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
AIR	6,261.0000	9,530.0000
FOB	6,366.0000	9,342.0000

##### Result table of run 6:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
REG AIR	6,271.0000	9,216.0000
SHIP	6,261.0000	9,335.0000

##### Result table of run 7:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
FOB	6,366.0000	9,342.0000
RAIL	6,252.0000	9,306.0000

##### Result table of run 8:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
AIR	6,290.0000	9,263.0000
RAIL	6,365.0000	9,340.0000

##### Result table of run 9:

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
AIR	6,293.0000	9,123.0000
RAIL	6,313.0000	9,320.0000

**Result table of run 10:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,085.0000	9,309.0000
SHIP	6,266.0000	9,251.0000

**Result table of run 11:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
AIR	6,293.0000	9,123.0000
SHIP	6,200.0000	9,262.0000

**Result table of run 12:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
AIR	6,293.0000	9,123.0000
FOB	6,224.0000	9,261.0000

**Result table of run 13:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
REG AIR	6,246.0000	9,245.0000
TRUCK	6,180.0000	9,241.0000

**Result table of run 14:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,202.0000	9,324.0000
REG AIR	6,246.0000	9,245.0000

**Result table of run 15:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
FOB	6,273.0000	9,429.0000
SHIP	6,262.0000	9,439.0000

**Result table of run 16:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,085.0000	9,309.0000
RAIL	6,252.0000	9,306.0000

**Result table of run 17:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
FOB	6,224.0000	9,261.0000
MAIL	6,202.0000	9,324.0000

**Result table of run 18:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,252.0000	9,376.0000
REG AIR	6,281.0000	9,291.0000

**Result table of run 19:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,202.0000	9,324.0000
TRUCK	6,180.0000	9,241.0000

**Result table of run 20:**

L_SHIPMODE	HIGH_LINE_COUNT	LOW_LINE_COUNT
MAIL	6,244.0000	9,329.0000
TRUCK	6,156.0000	9,206.0000

## 4.19 Query 21: Customer Distribution (TPC-H Q13)

### 4.19.1 Parameter

	WORD1	WORD2
1	pending	deposits
2	special	requests
3	pending	deposits
4	express	accounts
5	special	accounts
6	special	requests
7	special	deposits
8	unusual	deposits
9	unusual	packages
10	unusual	deposits
11	express	requests
12	express	deposits
13	unusual	requests
14	express	requests
15	express	deposits
16	special	deposits
17	unusual	accounts
18	express	accounts
19	unusual	accounts
20	unusual	requests

### 4.19.2 Received Data

**Result hash of run 1:**

hash  
d58c32f7b353b24fd2498fcb9ce883444fc70a8e016bf900b80d23

**Result hash of run 2:**

hash  
15549acf0edd863227e016faa447eea81c01ec249e76c5d8ecc5b77b

**Result hash of run 3:**

hash  
d58c32f7b353b24fd2498fcb9ce883444fc70a8e016bf900b80d23

**Result hash of run 4:**

hash  
1c3f213ad556e47da98f79ce72cf83508a5071476616b85355ebfe75

**Result hash of run 5:**

hash  
49f9ecaca3f1e9ced3657c7d45ef10e25c71d38b6e4179ff1b65f0c

**Result hash of run 6:**

hash  
15549acf0edd863227e016faa447eea81c01ec249e76c5d8ecc5b77b

**Result hash of run 7:**

hash  
a2ea9dbe397683d6446f5e06e05b587fe05cfaf567039f5066df02c0

**Result hash of run 8:**

hash  
9a8ce33c32f4aa5864b6cf9aa4a8d0ca6166bbac6145d050b66a03d6

**Result hash of run 9:**

hash  
86793226d6a520f650c092a34c3d73a43804bd1b38b0a51d173be78d

**Result hash of run 10:**

hash  
9a8ce33c32f4aa5864b6cf9aa4a8d0ca6166bbac6145d050b66a03d6

**Result hash of run 11:**

hash  
f1f3ebdf22c5ba8c93a87866675af456c78061b48893535bde2ebd5f

**Result hash of run 12:**

hash  
2d45f6d132a2fc0f0e450af7f4116418b0d95c54c6d18f093a6efecc

**Result hash of run 13:**

hash  
07a982be476de0f11cde95a059ec39383cd4266a1b8e385047937387

**Result hash of run 14:** hash  
f1f3ebdf22c5ba8c93a87866675af456c78061b48893535bde2ebd5f

**Result hash of run 15:** hash  
2d45f6d132a2fc0f0e450af7f4116418b0d95c54c6d18f093a6efecc

**Result hash of run 16:** hash  
a2ea9dbe397683d6446f5e06e05b587fe05cfaf567039f5066df02c0

**Result hash of run 17:** hash  
a7737b2595bcb9d971a5cbb2c7e7a1b71031c7f791db2d784ae20497

**Result hash of run 18:** hash  
1c3f213ad556e47da98f79ce72cf83508a5071476616b85355ebfe75

**Result hash of run 19:** hash  
a7737b2595bcb9d971a5cbb2c7e7a1b71031c7f791db2d784ae20497

**Result hash of run 20:** hash  
07a982be476de0f11cde95a059ec39383cd4266a1b8e385047937387

## 4.20 Query 22: Forecasting Revenue Change (TPC-H Q14)

In-Memory A: Different query

```
select
100.00 * sum(case
when p_type like 'PROMO%'
then l_extendedprice*(1-l_discount)
else 0
end) / sum(l_extendedprice * (1 - l_discount)) as promo_revenue
from
lineitem,
part
where
l_partkey = p_partkey
and l_shipdate >= date( '{DATE}')
and l_shipdate < date('{DATE}') + interval '1' month
limit 10000000
```

In-Memory B: Different query

```
select
100.00 * sum(case
when p_type like 'PROMO%'
then l_extendedprice*(1-l_discount)
else 0
end) / sum(l_extendedprice * (1 - l_discount)) as promo_revenue
from
lineitem,
part
where
l_partkey = p_partkey
and l_shipdate >= date( '{DATE}')
and l_shipdate < date('{DATE}') + interval '1' month
limit 10000000
```

### 4.20.1 Error

GPU DBMS E: numRun 1: : java.sql.SQLException: Query failed : Exception: Overflow or underflow

GPU DBMS F: numRun 1: : java.sql.SQLException: Query failed : Exception: Overflow or underflow

#### 4.20.2 Parameter

	DATE
1	1996-12-01
2	1995-02-01
3	1994-05-01
4	1996-07-01
5	1996-04-01
6	1994-11-01
7	1994-08-01
8	1997-01-01
9	1993-08-01
10	1994-12-01
11	1993-06-01
12	1997-01-01
13	1996-06-01
14	1996-03-01
15	1995-08-01
16	1995-07-01
17	1996-08-01
18	1996-01-01
19	1996-05-01
20	1995-07-01

#### 4.20.3 Received Data

##### Result table of run 1:

PROMO.REVENUE
16.5794

##### Result table of run 2:

PROMO.REVENUE
16.5605

##### Result table of run 3:

PROMO.REVENUE
16.5107

##### Result table of run 4:

PROMO.REVENUE
16.3677

##### Result table of run 5:

PROMO.REVENUE
16.6512

##### Result table of run 6:

PROMO.REVENUE
16.4869

##### Result table of run 7:

PROMO.REVENUE
16.4584

##### Result table of run 8:

PROMO.REVENUE
16.3968

##### Result table of run 9:

PROMO.REVENUE
16.3439

##### Result table of run 10:

PROMO.REVENUE
16.4170

##### Result table of run 11:

PROMO.REVENUE
16.6777

##### Result table of run 12:

PROMO.REVENUE
16.3968

##### Result table of run 13:

PROMO.REVENUE
16.4120

##### Result table of run 14:

PROMO.REVENUE
16.6105

**Result table of run 15:**

PROMO.REVENUE
16.5754

**Result table of run 16:**

PROMO.REVENUE
16.2894

**Result table of run 17:**

PROMO.REVENUE
16.5350

**Result table of run 18:**

PROMO.REVENUE
16.5841

**Result table of run 19:**

PROMO.REVENUE
16.2164

**Result table of run 20:**

PROMO.REVENUE
16.2894

## 4.21 Query 24: Parts/Supplier Relationship (TPC-H Q16)

### 4.21.1 Parameter

	BRAND	SIZE1	SIZE2	SIZE3	SIZE4	SIZE5	SIZE6	SIZE7	SIZE8	TYPE
1	Brand#45	11	28	2	38	16	37	27	22	MEDIUM POLISHED
2	Brand#45	25	16	41	35	22	34	36	5	MEDIUM POLISHED
3	Brand#45	1	36	35	6	41	42	10	33	MEDIUM POLISHED
4	Brand#45	10	3	34	46	19	48	28	36	MEDIUM POLISHED
5	Brand#45	22	20	17	34	26	13	18	16	MEDIUM POLISHED
6	Brand#45	37	19	13	3	36	35	38	2	MEDIUM POLISHED
7	Brand#45	1	3	37	10	46	44	4	29	MEDIUM POLISHED
8	Brand#45	2	45	19	8	46	48	20	44	MEDIUM POLISHED
9	Brand#45	27	8	1	29	28	2	11	34	MEDIUM POLISHED
10	Brand#45	23	33	22	48	12	30	24	44	MEDIUM POLISHED
11	Brand#45	31	35	30	19	7	29	20	22	MEDIUM POLISHED
12	Brand#45	31	45	22	43	50	41	11	28	MEDIUM POLISHED
13	Brand#45	19	46	23	1	29	37	22	44	MEDIUM POLISHED
14	Brand#45	30	23	20	35	40	9	42	43	MEDIUM POLISHED
15	Brand#45	26	30	6	31	35	17	10	41	MEDIUM POLISHED
16	Brand#45	15	33	27	3	18	36	38	6	MEDIUM POLISHED
17	Brand#45	14	17	3	24	43	50	22	48	MEDIUM POLISHED
18	Brand#45	39	1	46	48	21	44	35	19	MEDIUM POLISHED
19	Brand#45	18	43	5	38	46	47	29	33	MEDIUM POLISHED
20	Brand#45	47	23	18	12	48	40	29	32	MEDIUM POLISHED

### 4.21.2 Received Data

**Result hash of run 1:**

hash  
8e3a41cf78acb25696804e8b664ca5fdb0e7c73b586b2aeb38e46729d

**Result hash of run 2:**

hash  
08fcab4091a56aab59a4047505dcc0272a56bc6cd8d2394642f25ab3

**Result hash of run 3:**

hash  
0a4366d4c269e6cb3fe22541faa408c3e56ac989bcc0fbfd4b203a4

**Result hash of run 4:**

hash  
6624ee032813a630145d09064be2e8baab26056f23f364a35588be95

**Result hash of run 5:**

hash  
8cb7ff8ec776ecf7c38255563d00f844dec90bf9884933ebda31b506

**Result hash of run 6:**

hash  
150ef33628e4a26c3b7c2af6297544b1611e282d77cc8234f04f2490

**Result hash of run 7:**

hash  
f7ab8ae36dd0b21ef949c549711903050c57efca7b0cbf7e5bc1083a

**Result hash of run 8:**

hash  
27c7ef19cab7158b5109d4ee552bc33587da79de3206232454fa1c53

**Result hash of run 9:**

hash  
7d10be6ec325675a8ad6b8a4ed12da48df8f4fed8f8f05be2818dc5a

**Result hash of run 10:**

hash  
364cd12598ffa98c857ee4cd5e58af63bb70440ee60e79970bccf3f7

**Result hash of run 11:**

hash  
9ef64718c4abbc53e96ea9e81f83fd50b3c679e2f9ad66ab713a0e74

**Result hash of run 12:**

hash  
0fed2139023775badb23d490dbc441e90e51f482a6ad467fb204b4c7

**Result hash of run 13:**

hash  
ecf1808ac71066d32649dc99dd56443016d8db506f5472cfbee058b

**Result hash of run 14:** hash  
391e7f0c3b06a64d08728bf78f64e1f33cc9a2885251bf0cc5595ed1

**Result hash of run 15:** hash  
1cb8dc22cb9ed0668714a0531a5300ca64c4bc0d6ad9716cf569ca21

**Result hash of run 16:** hash  
55645011aafed2daf1a51d6f92db07ed1e77982bd514eaad733923b3

**Result hash of run 17:** hash  
4f49a30a82ffdbeced98a80d3e274d2722b0e19fdbd33cd257c009b5e

**Result hash of run 18:** hash  
92f759228b92cb55e20d1a34e6f9f2126fd661d0d6f73735b9093e3d

**Result hash of run 19:** hash  
537b330b020230dd8c950092fd3d7c419647fa47190798335a0d3bf7

**Result hash of run 20:** hash  
ea813cc709533dc8d6b9ebdb9c586ab2f085dca5f684313c1c4c868b

## 4.22 Query 26: Large Volume Customer (TPC-H Q18)

In-Memory A: Different query

```
select
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice ,
cast(sum(l_quantity) as unsigned integer) as sum_quant
from
customer,
orders,
lineitem
where
o_orderkey in (
select
l_orderkey
from
lineitem
group by
l_orderkey having
sum(l_quantity) > {QUANTITY}
)
and c_custkey = o_custkey
and o_orderkey = l_orderkey
group by
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice
order by
o_totalprice desc,
o_orderdate
limit 10000000
```

In-Memory B: Different query

```
select
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice ,
cast(sum(l_quantity) as unsigned integer) as sum_quant
from
customer,
orders,
lineitem
where
o_orderkey in (
select
l_orderkey
from
lineitem
group by
l_orderkey having
sum(l_quantity) > {QUANTITY}
)
and c_custkey = o_custkey
and o_orderkey = l_orderkey
```

```

group by
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice
order by
o_totalprice desc,
o_orderdate
limit 10000000

```

#### 4.22.1 Parameter

	QUANTITY
1	315
2	313
3	314
4	315
5	312
6	312
7	315
8	313
9	314
10	312
11	314
12	315
13	315
14	313
15	315
16	313
17	314
18	314
19	312
20	314

#### 4.22.2 Received Data

**Result hash of run 1:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 2:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 3:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 4:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 5:**

hash  
f4da08987c07b62c7b40127ab6ed9f6063531deed176d9fa230e89f3

**Result hash of run 6:**

hash  
f4da08987c07b62c7b40127ab6ed9f6063531deed176d9fa230e89f3

**Result hash of run 7:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 8:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 9:**

hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 10:** hash  
f4da08987c07b62c7b40127ab6ed9f6063531deed176d9fa230e89f3

**Result hash of run 11:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 12:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 13:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 14:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 15:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 16:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 17:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 18:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

**Result hash of run 19:** hash  
f4da08987c07b62c7b40127ab6ed9f6063531deed176d9fa230e89f3

**Result hash of run 20:** hash  
c7ff4c5be1d614d1d29ef1870a7431f896ae2b28f9477eeb5cc0909a

## 4.23 Query 27: Discounted Revenue (TPC-H Q19)

### 4.23.1 Parameter

	BRAND1	BRAND2	BRAND3	QUANTITY1	QUANTITY2	QUANTITY3
1	Brand#12	Brand#23	Brand#34	3	12	20
2	Brand#12	Brand#23	Brand#34	2	20	29
3	Brand#12	Brand#23	Brand#34	2	20	21
4	Brand#12	Brand#23	Brand#34	2	12	24
5	Brand#12	Brand#23	Brand#34	4	18	22
6	Brand#12	Brand#23	Brand#34	2	15	28
7	Brand#12	Brand#23	Brand#34	4	18	28
8	Brand#12	Brand#23	Brand#34	6	19	28
9	Brand#12	Brand#23	Brand#34	9	13	26
10	Brand#12	Brand#23	Brand#34	8	14	29
11	Brand#12	Brand#23	Brand#34	2	17	27
12	Brand#12	Brand#23	Brand#34	6	15	21
13	Brand#12	Brand#23	Brand#34	1	11	27
14	Brand#12	Brand#23	Brand#34	1	16	30
15	Brand#12	Brand#23	Brand#34	3	17	22
16	Brand#12	Brand#23	Brand#34	1	20	30
17	Brand#12	Brand#23	Brand#34	10	10	26
18	Brand#12	Brand#23	Brand#34	5	11	29
19	Brand#12	Brand#23	Brand#34	2	11	30
20	Brand#12	Brand#23	Brand#34	2	20	26

### 4.23.2 Received Data

**Result table of run 1:**

REVENUE
3,239,498.0216

**Result table of run 2:**

REVENUE
4,394,631.6444

**Result table of run 3:**

REVENUE
3,674,375.6620

**Result table of run 4:**

REVENUE
3,528,544.2750

**Result table of run 5:**

REVENUE
3,782,438.0719

**Result table of run 6:**

REVENUE
4,206,922.0563

**Result table of run 7:**

REVENUE
4,446,179.2151

**Result table of run 8:**

REVENUE
4,575,212.7125

**Result table of run 9:**

REVENUE
4,178,700.7688

**Result table of run 10:**

REVENUE
4,193,670.5979

**Result table of run 11:**

REVENUE
4,374,028.8011

**Result table of run 12:**

REVENUE
3,646,921.3085

**Result table of run 13:**

REVENUE
3,957,228.0866

**Result table of run 14:**

REVENUE
4,353,827.5850

**Result table of run 15:**

REVENUE
3,690,309.5489

**Result table of run 16:**

REVENUE
4,481,456.7710

**Result table of run 17:**

REVENUE
4,107,009.6746

**Result table of run 18:**

REVENUE
3,955,945.0951

**Result table of run 19:**

REVENUE
4,037,054.2929

**Result table of run 20:**

REVENUE
4,348,837.1247

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40	Query 9: Time datatransfer . . . . .	60
41	Query 9: Time connection . . . . .	61
42	Query 11: Server Hardware Metrics . . . . .	63
43	Query 11: Time execution . . . . .	64
44	Query 11: Time datatransfer . . . . .	65
45	Query 11: Time connection . . . . .	66
46	Query 13: Server Hardware Metrics . . . . .	68
47	Query 13: Time execution . . . . .	69
48	Query 13: Time datatransfer . . . . .	70

49	Query 13: Time connection . . . . .	71
50	Query 14: Server Hardware Metrics . . . . .	73
51	Query 14: Time execution . . . . .	74
52	Query 14: Time datatransfer . . . . .	75
53	Query 14: Time connection . . . . .	76
54	Query 15: Server Hardware Metrics . . . . .	78
55	Query 15: Time execution . . . . .	79
56	Query 15: Time datatransfer . . . . .	80
57	Query 15: Time connection . . . . .	81
58	Query 17: Server Hardware Metrics . . . . .	83
59	Query 17: Time execution . . . . .	84
60	Query 17: Time datatransfer . . . . .	85
61	Query 17: Time connection . . . . .	86
62	Query 18: Server Hardware Metrics . . . . .	88
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65	Query 18: Time connection . . . . .	91
66	Query 19: Server Hardware Metrics . . . . .	93
67	Query 19: Time execution . . . . .	94
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69	Query 19: Time connection . . . . .	96
70	Query 20: Server Hardware Metrics . . . . .	98
71	Query 20: Time execution . . . . .	99
72	Query 20: Time datatransfer . . . . .	100
73	Query 20: Time connection . . . . .	101
74	Query 21: Server Hardware Metrics . . . . .	103
75	Query 21: Time execution . . . . .	104
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78	Query 22: Server Hardware Metrics . . . . .	108
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