TPC-DS Benchmark Results: TabbyDB vs. Apache Spark on AWS r6gd.4xlarge Cluster

Overview

This whitepaper presents the results of a TPC-DS benchmark comparing **TabbyDB** with **stock Apache Spark** on an **AWS r6gd.4xlarge 6-node cluster**. The benchmark evaluated performance on **1TB** and **2TB** TPC-DS datasets. The results show that TabbyDB achieved a **13% improvement in total runtime performance** over unmodified Apache Spark, demonstrating the efficiency of TabbyDB's query execution optimizations, **in practical situations when the columns involved in join are un-partitioned**.

Test Objective

The goal of this benchmark was to quantify the performance gains achieved by TabbyDB's enhancements to Spark's query execution engine, involving Broadcast Hash Joins, when the **joining columns are un-partitioned**

Environment Setup

All tests were performed using an **AWS cluster with six r6gd.4xlarge nodes** (16 vCPUs, 128 GB memory, NVMe SSD storage). The TPC-DS benchmark was executed for **1TB** and **2TB** scale factors (1000, and 2000 respectively), with identical cluster and software configurations for both systems.
6 identical AWS instances

Instance type	**r6gd.4xlarge**
Memory	**128 GB**
Storage	**950 GB**
Storage Type	**SSD**

Configuration Details:

- Standalone Spark Cluster with 6 nodes
- HDFS as data store
- Node 1 designated as Spark Master, Spark Driver, Name Node, Data Node
- Node2 - Node6 designated as Data Node and Executor

spark-defaults.conf

	1 TB	2 TB
spark.sql.autoBroadcastJoinThreshold	104857600	209715200
spark.driver.maxResultSize	8192MB	8192MB
spark.sql.catalogImplementation	hive	hive
spark.sql.files.maxPartitionBytes	512MB	1024MB
spark.sql.shuffle.partitions	400	800

Driver Node Spark Configuration

spark-env.sh

export SPARK_DRIVER_MEMORY=8G

export SPARK_WORKER_CORES=12

export SPARK_WORKER_MEMORY=664G

export SPARK_EXECUTOR_CORES=3

export SPARK_EXECUTOR_MEMORY=16G

export SPARK_WORKER_INSTANCES=1

export SPARK_LOCAL_DIRS= <Volume mounted on ephemeral stores>

Executor Node Spark Configuration

spark-env.sh

export SPARK_DRIVER_MEMORY=8G

export SPARK_WORKER_CORES=15

export SPARK_WORKER_MEMORY=664G

export SPARK_EXECUTOR_CORES=3

export SPARK_EXECUTOR_MEMORY=24G

export SPARK_WORKER_INSTANCES=1

export SPARK_LOCAL_DIRS= <Volume mounted on ephemeral stores>

Methodology

TPCDS Data generated using instructions given by

https://github.com/databricks/spark-sql-perf

With following patch to be applied to the master branch

This modification ensures following:

- **All tables created are un-partitioned (i.e no partition column defined)**
- **The data generated in each split is locally sorted on date column, for the “sales” tables.**

diff --git a/src/main/scala/com/databricks/spark/sql/perf/Tables.scala
b/src/main/scala/com/databricks/spark/sql/perf/Tables.scala
index 177d38c..bec425a 100644
--- a/src/main/scala/com/databricks/spark/sql/perf/Tables.scala

```
+++ b/src/main/scala/com/databricks/spark/sql/perf/Tables.scala
@@ -177,7 +177,18 @@ abstract class Tables(sqlContext: SQLContext, scaleFactor: String,
     numPartitions: Int): Unit = {
     val mode = if (overwrite) SaveMode.Overwrite else SaveMode.Ignore

-    val data = df(format != "text", numPartitions)
+    val dataTemp = df(format != "text", numPartitions)
+    val data = if (name.toLowerCase.contains("store_sales")) {
+      dataTemp.sortWithinPartitions("ss_sold_date_sk")
+    } else if (name.toLowerCase.contains("web_sales")) {
+      dataTemp.sortWithinPartitions("ws_sold_date_sk")
+    } else if (name.toLowerCase.contains("catalog_sales")) {
+      dataTemp.sortWithinPartitions("cs_sold_date_sk")
+    } else {
+      dataTemp
+    }
+
+
     val tempTableName = s"${name}_text"
     data.createOrReplaceTempView(tempTableName)

@@ -291,7 +302,8 @@ abstract class Tables(sqlContext: SQLContext, scaleFactor: String,
     filterOutNullPartitionValues: Boolean,
     tableFilter: String = "",
     numPartitions: Int = 100): Unit = {
-  var tablesToBeGenerated = if (partitionTables) {
+  // DO NOT GENERATE PARTITIONED TABLES
+  var tablesToBeGenerated = if (false) {
     tables
   } else {
     tables.map(_.nonPartitioned)
```

The benchmark followed standard TPC-DS methodology:

- All 99 queries from the official TPC-DS suite were executed.

- Each query was run under identical cluster conditions
- The total runtime for all queries was recorded and compared between the two systems.

Results Summary

Across both dataset scales, **TabbyDB outperformed stock Apache Spark**, showing **13% reduction in total runtime** on average.

1 TB run Results

Query Number(oss)	Query Number(wf)	Time Taken Stock Spark	Resultsize Stock Spark	Time Taken TabbyDB	Resultsize TabbyDB	Time Diff seconds	Row Count Match	Time Percent
q1-v2.4	q1-v2.4	11.1	100	11.3	100	0.2	TRUE	1.801801802
q2-v2.4	q2-v2.4	10.5	2513	8.8	2513	-1.7	TRUE	-16.19047619
q3-v2.4	q3-v2.4	4.4	100	2.8	100	-1.6	TRUE	-36.36363636
q4-v2.4	q4-v2.4	90.9	100	84	100	-6.9	TRUE	-7.590759076
q5-v2.4	q5-v2.4	26.6	100	18.1	100	-8.5	TRUE	-31.95488722
q6-v2.4	q6-v2.4	5.5	52	5.2	52	-0.3	TRUE	-5.454545455
q7-v2.4	q7-v2.4	8.4	100	4.4	100	-4	TRUE	-47.61904762
q8-v2.4	q8-v2.4	8.2	10	6.5	10	-1.7	TRUE	-20.73170732
q9-v2.4	q9-v2.4	15.6	1	16.5	1	0.9	TRUE	5.769230769

q10-v2.4	q10-v2.4	8.7	100	6.2	100	-2.5	TRUE	-28.73563218
q11-v2.4	q11-v2.4	40.6	100	35.7	100	-4.9	TRUE	-12.06896552
q12-v2.4	q12-v2.4	3.4	100	2	100	-1.4	TRUE	-41.17647059
q13-v2.4	q13-v2.4	11.4	1	7	1	-4.4	TRUE	-38.59649123
q14a-v2.4	q14a-v2.4	72	100	61.6	100	-10.4	TRUE	-14.44444444
q14b-v2.4	q14b-v2.4	62.7	100	58.6	100	-4.1	TRUE	-6.53907496
q15-v2.4	q15-v2.4	18.1	100	10.3	100	-7.8	TRUE	-43.09392265
q16-v2.4	q16-v2.4	22.2	1	20.2	1	-2	TRUE	-9.009009009
q17-v2.4	q17-v2.4	16.4	100	11.7	100	-4.7	TRUE	-28.65853659
q18-v2.4	q18-v2.4	12.1	100	8.6	100	-3.5	TRUE	-28.92561983
q19-v2.4	q19-v2.4	13.5	100	8.4	100	-5.1	TRUE	-37.77777778

q20-v2.4	q20-v2.4	4.8	100	3.3	100	-1.5	TRUE	-31.25
q21-v2.4	q21-v2.4	2.9	100	1.6	100	-1.3	TRUE	-44.8275 8621
q22-v2.4	q22-v2.4	16	100	15.3	100	-0.7	TRUE	-4.375
q23a-v2.4	q23a-v2.4	123.7	1	118.8	1	-4.9	TRUE	-3.96119 6443
q23b-v2.4	q23b-v2.4	129.4	100	123	100	-6.4	TRUE	-4.94590 4173
q24a-v2.4	q24a-v2.4	45.4	2919	46.3	2919	0.9	TRUE	1.98237 8855
q24b-v2.4	q24b-v2.4	43.9	322	39.4	322	-4.5	TRUE	-10.2505 6948
q25-v2.4	q25-v2.4	13.6	100	8.9	100	-4.7	TRUE	-34.5588 2353
q26-v2.4	q26-v2.4	4.6	100	2.7	100	-1.9	TRUE	-41.3043 4783
q27-v2.4	q27-v2.4	7.8	100	2.9	100	-4.9	TRUE	-62.8205 1282
q28-v2.4	q28-v2.4	22.6	1	23.1	1	0.5	TRUE	2.21238 9381
q29-v2.4	q29-v2.4	28.8	100	25.3	100	-3.5	TRUE	-12.1527 7778

q30-v2.4	q30-v2.4	9.9	100	9.1	100	-0.8	TRUE	-8.080808081
q31-v2.4	q31-v2.4	17	278	9.2	278	-7.8	TRUE	-45.88235294
q32-v2.4	q32-v2.4	4.2	1	1.8	1	-2.4	TRUE	-57.14285714
q33-v2.4	q33-v2.4	8.4	100	4.9	100	-3.5	TRUE	-41.66666667
q34-v2.4	q34-v2.4	5	8489	3.3	8489	-1.7	TRUE	-34
q35-v2.4	q35-v2.4	13	100	11.1	100	-1.9	TRUE	-14.615384 62
q36-v2.4	q36-v2.4	6.4	100	2.9	100	-3.5	TRUE	-54.6875
q37-v2.4	q37-v2.4	4.7	12	4.8	12	0.1	TRUE	2.127659574
q38-v2.4	q38-v2.4	27.3	1	23.2	1	-4.1	TRUE	-15.01831502
q39a-v2.4	q39a-v2.4	7.3	14551	5.1	14551	-2.2	TRUE	-30.1369863
q39b-v2.4	q39b-v2.4	6.6	594	4.7	594	-1.9	TRUE	-28.78787879
q40-v2.4	q40-v2.4	6.3	100	7.4	100	1.1	TRUE	17.46031746

q41-v2.4	q41-v2.4	0.7	100	0.7	100	0	TRUE	0
q42-v2.4	q42-v2.4	3.2	13	0.8	13	-2.4	TRUE	-75
q43-v2.4	q43-v2.4	4.4	100	2.6	100	-1.8	TRUE	-40.90909091
q44-v2.4	q44-v2.4	6.4	10	6.5	10	0.1	TRUE	1.5625
q45-v2.4	q45-v2.4	10.5	100	8.8	100	-1.7	TRUE	-16.19047619
q46-v2.4	q46-v2.4	11.8	100	9.1	100	-2.7	TRUE	-22.88135593
q47-v2.4	q47-v2.4	17.4	100	14.2	100	-3.2	TRUE	-18.3908046
q48-v2.4	q48-v2.4	15.1	1	5.6	1	-9.5	TRUE	-62.91390728
q49-v2.4	q49-v2.4	15	100	7.3	100	-7.7	TRUE	-51.33333333
q50-v2.4	q50-v2.4	56.2	100	55.5	100	-0.7	TRUE	-1.245551601
q51-v2.4	q51-v2.4	28.2	100	26.4	100	-1.8	TRUE	-6.382978723
q52-v2.4	q52-v2.4	3.5	100	1	100	-2.5	TRUE	-71.42857143

q53-v2.4	q53-v2.4	4.8	100	2.7	100	-2.1	TRUE	-43.75
q54-v2.4	q54-v2.4	15.3	100	11.3	100	-4	TRUE	-26.1437 9085
q55-v2.4	q55-v2.4	3.3	100	1.1	100	-2.2	TRUE	-66.6666 6667
q56-v2.4	q56-v2.4	8.6	100	5.4	100	-3.2	TRUE	-37.2093 0233
q57-v2.4	q57-v2.4	10.1	100	8.9	100	-1.2	TRUE	-11.8811 8812
q58-v2.4	q58-v2.4	9.9	6	10.9	6	1	TRUE	10.1010 101
q59-v2.4	q59-v2.4	9.4	100	9.1	100	-0.3	TRUE	-3.19148 9362
q60-v2.4	q60-v2.4	7.6	100	5.2	100	-2.4	TRUE	-31.5789 4737
q61-v2.4	q61-v2.4	17.2	1	10.1	1	-7.1	TRUE	-41.2790 6977
q62-v2.4	q62-v2.4	4.2	100	3.3	100	-0.9	TRUE	-21.4285 7143
q63-v2.4	q63-v2.4	4.5	100	2.2	100	-2.3	TRUE	-51.1111 1111

q64-v2.4	q64-v2.4	77.4	12185	65	12185	-12.4	TRUE	-16.02067183
q65-v2.4	q65-v2.4	30.7	100	27.2	100	-3.5	TRUE	-11.40065147
q66-v2.4	q66-v2.4	8.2	20	5.2	20	-3	TRUE	-36.58536585
q67-v2.4	q67-v2.4	133.4	100	128.6	100	-4.8	TRUE	-3.5982009
q68-v2.4	q68-v2.4	12.3	100	7.4	100	-4.9	TRUE	-39.837398 37
q69-v2.4	q69-v2.4	6.2	100	6.4	100	0.2	TRUE	3.225806452
q70-v2.4	q70-v2.4	10.3	49	7	49	-3.3	TRUE	-32.03883495
q71-v2.4	q71-v2.4	7.6	207916	2.3	207916	-5.3	TRUE	-69.73684211
q72-v2.4	q72-v2.4	32.7	100	31.9	100	-0.8	TRUE	-2.44648318
q73-v2.4	q73-v2.4	4.6	253	2.3	253	-2.3	TRUE	-50
q74-v2.4	q74-v2.4	34.2	100	30.7	100	-3.5	TRUE	-10.23391813

q75-v2.4	q75-v2.4	33.7	29	23.9	29	-9.8	TRUE	-29.0801 1869
q76-v2.4	q76-v2.4	6.5	100	6.7	100	0.2	TRUE	3.07692 3077
q77-v2.4	q77-v2.4	8.6	100	3.6	100	-5	TRUE	-58.1395 3488
q78-v2.4	q78-v2.4	87.7	100	81.5	100	-6.2	TRUE	-7.06955 5302
q79-v2.4	q79-v2.4	8.5	100	6.1	100	-2.4	TRUE	-28.2352 9412
q80-v2.4	q80-v2.4	27	100	18.1	100	-8.9	TRUE	-32.9629 6296
q81-v2.4	q81-v2.4	9	100	9.1	100	0.1	TRUE	1.111111 111
q82-v2.4	q82-v2.4	10.3	19	9.7	19	-0.6	TRUE	-5.82524 2718
q83-v2.4	q83-v2.4	3.4	100	3.4	100	0	TRUE	0
q84-v2.4	q84-v2.4	NULL	0	NULL	0	0	TRUE	0
q85-v2.4	q85-v2.4	7.3	64	8.9	64	1.6	TRUE	21.9178 0822
q86-v2.4	q86-v2.4	4	100	3.2	100	-0.8	TRUE	-20

q87-v2.4	q87-v2.4	25.5	1	23.3	1	-2.2	TRUE	-8.62745098
q88-v2.4	q88-v2.4	20.6	1	19	1	-1.6	TRUE	-7.766990291
q89-v2.4	q89-v2.4	6.3	100	3.3	100	-3	TRUE	-47.61904762
q90-v2.4	q90-v2.4	2.1	1	2.3	1	0.2	TRUE	9.523809524
q91-v2.4	q91-v2.4	9.9	42	2.6	42	-7.3	TRUE	-73.737377374
q92-v2.4	q92-v2.4	2.8	1	1.6	1	-1.2	TRUE	-42.857142286
q93-v2.4	q93-v2.4	102.3	100	102	100	-0.3	TRUE	-0.293255132
q94-v2.4	q94-v2.4	14.4	1	13.2	1	-1.2	TRUE	-8.333333333
q95-v2.4	q95-v2.4	50.1	1	50.2	1	0.1	TRUE	0.1996007984
q96-v2.4	q96-v2.4	2.9	1	2.6	1	-0.3	TRUE	-10.344827759
q97-v2.4	q97-v2.4	35.4	1	32.8	1	-2.6	TRUE	-7.344632768

q98-v2.4	q98-v2.4	6.9	44858	2.7	44858	-4.2	TRUE	-60.86956522
q99-v2.4	q99-v2.4	6.4	100	4.6	100	-1.8	TRUE	-28.125
ss_max-v2.4	ss_max-v2.4	10.2	1	10.3	1	0.1	TRUE	0.9803921569
		2148.6		1853.4		-295.2		
					% improvement	13.739179		

2 TB run Results

Query Number(oss)	Query Number(wf)	Time Taken Stock Spark	Resultsize Stock Spark	Time Taken TabbyDB	Resultsize TabbyDB	Time Diff seconds	Row Count Match	Time Percent
q1-v2.4	q1-v2.4	15.6	100	15.2	100	-0.4	TRUE	-2.564102564
q2-v2.4	q2-v2.4	16.9	2513	11.5	2513	-5.4	TRUE	-31.95266272

q3-v2.4	q3-v2.4	6.9	100	2.8	100	-4.1	TRUE	-59.4202 8986
q4-v2.4	q4-v2.4	171.5	100	148.4	100	-23.1	TRUE	-13.4693 8776
q5-v2.4	q5-v2.4	49	100	32.6	100	-16.4	TRUE	-33.4693 8776
q6-v2.4	q6-v2.4	9.2	52	9.3	52	0.1	TRUE	1.08695 6522
q7-v2.4	q7-v2.4	14.8	100	7.5	100	-7.3	TRUE	-49.3243 2432
q8-v2.4	q8-v2.4	13.3	10	9.1	10	-4.2	TRUE	-31.5789 4737
q9-v2.4	q9-v2.4	30.2	1	31	1	0.8	TRUE	2.64900 6623
q10-v2.4	q10-v2.4	17.6	100	12.7	100	-4.9	TRUE	-27.8409 0909
q11-v2.4	q11-v2.4	73.6	100	63.1	100	-10.5	TRUE	-14.2663 0435
q12-v2.4	q12-v2.4	4.9	100	2.2	100	-2.7	TRUE	-55.1020 4082
q13-v2.4	q13-v2.4	20.6	1	9.1	1	-11.5	TRUE	-55.8252 4272

q14a-v2.4	q14a-v2.4	150.5	100	137.3	100	-13.2	TRUE	-8.77076412
q14b-v2.4	q14b-v2.4	131.6	100	117.2	100	-14.4	TRUE	-10.94224924
q15-v2.4	q15-v2.4	34.4	100	21.4	100	-13	TRUE	-37.79069767
q16-v2.4	q16-v2.4	39.7	1	38.7	1	-1	TRUE	-2.518891688
q17-v2.4	q17-v2.4	33.9	100	24.7	100	-9.2	TRUE	-27.13864307
q18-v2.4	q18-v2.4	20.1	100	15.7	100	-4.4	TRUE	-21.89054726
q19-v2.4	q19-v2.4	21.8	100	15.6	100	-6.2	TRUE	-28.44036697
q20-v2.4	q20-v2.4	10.6	100	7.6	100	-3	TRUE	-28.30188679
q21-v2.4	q21-v2.4	3	100	2.4	100	-0.6	TRUE	-20
q22-v2.4	q22-v2.4	23.2	100	22.6	100	-0.6	TRUE	-2.586206897
q23a-v2.4	q23a-v2.4	240.6	1	232.4	1	-8.2	TRUE	-3.408146301
q23b-v2.4	q23b-v2.4	250	100	240.5	100	-9.5	TRUE	-3.8

q24a-v2.4	q24a-v2.4	105.6	5585	104.5	5585	-1.1	TRUE	-1.041666667
q24b-v2.4	q24b-v2.4	100.4	585	97.9	585	-2.5	TRUE	-2.490039841
q25-v2.4	q25-v2.4	27.4	100	24.5	100	-2.9	TRUE	-10.58394161
q26-v2.4	q26-v2.4	8.7	100	4.6	100	-4.1	TRUE	-47.12643678
q27-v2.4	q27-v2.4	14.3	100	5.5	100	-8.8	TRUE	-61.53846154
q28-v2.4	q28-v2.4	42.7	1	42.5	1	-0.2	TRUE	-0.468384074 9
q29-v2.4	q29-v2.4	59.4	100	50.4	100	-9	TRUE	-15.15151515
q30-v2.4	q30-v2.4	16.5	100	14.6	100	-1.9	TRUE	-11.51515152
q31-v2.4	q31-v2.4	28.6	291	12.9	291	-15.7	TRUE	-54.89510 49
q32-v2.4	q32-v2.4	7.5	1	2.8	1	-4.7	TRUE	-62.66666667
q33-v2.4	q33-v2.4	14.3	100	9.2	100	-5.1	TRUE	-35.66433566

q34-v2.4	q34-v2.4	9.6	17171	4.5	17171	-5.1	TRUE	-53.125
q35-v2.4	q35-v2.4	25.4	100	24	100	-1.4	TRUE	-5.51181 1024
q36-v2.4	q36-v2.4	11.5	100	4.2	100	-7.3	TRUE	-63.4782 6087
q37-v2.4	q37-v2.4	8.2	12	7.6	12	-0.6	TRUE	-7.31707 3171
q38-v2.4	q38-v2.4	49.8	1	45.4	1	-4.4	TRUE	-8.83534 1365
q39a-v2.4	q39a-v2.4	12.3	16683	11.4	16683	-0.9	TRUE	-7.31707 3171
q39b-v2.4	q39b-v2.4	11.8	656	10.1	656	-1.7	TRUE	-14.4067 7966
q40-v2.4	q40-v2.4	14.7	100	11.7	100	-3	TRUE	-20.4081 6327
q41-v2.4	q41-v2.4	0.7	100	0.7	100	0	TRUE	0
q42-v2.4	q42-v2.4	5.5	13	1.2	13	-4.3	TRUE	-78.1818 1818
q43-v2.4	q43-v2.4	7.7	100	5.8	100	-1.9	TRUE	-24.6753 2468
q44-v2.4	q44-v2.4	12.7	10	12.9	10	0.2	TRUE	1.57480 315

q45-v2.4	q45-v2.4	19.6	100	14.9	100	-4.7	TRUE	-23.97959184
q46-v2.4	q46-v2.4	22.3	100	13.9	100	-8.4	TRUE	-37.66816143
q47-v2.4	q47-v2.4	31.3	100	27.1	100	-4.2	TRUE	-13.41853035
q48-v2.4	q48-v2.4	27.6	1	8.9	1	-18.7	TRUE	-67.75362319
q49-v2.4	q49-v2.4	27.8	100	18.1	100	-9.7	TRUE	-34.89208633
q50-v2.4	q50-v2.4	117.1	100	117.5	100	0.4	TRUE	0.341588386
q51-v2.4	q51-v2.4	51	100	44.8	100	-6.2	TRUE	-12.15686275
q52-v2.4	q52-v2.4	5.9	100	1.3	100	-4.6	TRUE	-77.96610169
q53-v2.4	q53-v2.4	8.9	100	3.8	100	-5.1	TRUE	-57.33707079
q54-v2.4	q54-v2.4	26.5	100	19.7	100	-6.8	TRUE	-25.66037736
q55-v2.4	q55-v2.4	5.6	100	1.2	100	-4.4	TRUE	-78.57142857

q56-v2.4	q56-v2.4	14.8	100	7.3	100	-7.5	TRUE	-50.67567568
q57-v2.4	q57-v2.4	21.5	100	16.4	100	-5.1	TRUE	-23.72093023
q58-v2.4	q58-v2.4	21.3	0	17.4	0	-3.9	TRUE	-18.30985915
q59-v2.4	q59-v2.4	17.5	100	12.6	100	-4.9	TRUE	-28
q60-v2.4	q60-v2.4	14.2	100	7.5	100	-6.7	TRUE	-47.18309859
q61-v2.4	q61-v2.4	31	1	18.2	1	-12.8	TRUE	-41.29032258
q62-v2.4	q62-v2.4	7.3	100	5.2	100	-2.1	TRUE	-28.76712329
q63-v2.4	q63-v2.4	8.8	100	3.5	100	-5.3	TRUE	-60.22727273
q64-v2.4	q64-v2.4	151.8	34960	124.8	34960	-27	TRUE	-17.78656126
q65-v2.4	q65-v2.4	56	100	50.4	100	-5.6	TRUE	-10
q66-v2.4	q66-v2.4	14.8	21	8.8	21	-6	TRUE	-40.54054054
q67-v2.4	q67-v2.4	457	100	456.5	100	-0.5	TRUE	-0.1094091904

q68-v2.4	q68-v2.4	25.2	100	14.5	100	-10.7	TRUE	-42.46031746
q69-v2.4	q69-v2.4	14.4	100	17.5	100	3.1	TRUE	21.52777778
q70-v2.4	q70-v2.4	21	64	17.8	64	-3.2	TRUE	-15.23809524
q71-v2.4	q71-v2.4	14.1	251269	4.1	251269	-10	TRUE	-70.92198582
q72-v2.4	q72-v2.4	53.1	100	49.1	100	-4	TRUE	-7.532956685
q73-v2.4	q73-v2.4	9	356	3.2	356	-5.8	TRUE	-64.44444444
q74-v2.4	q74-v2.4	64.3	100	58	100	-6.3	TRUE	-9.797822706
q75-v2.4	q75-v2.4	62.4	35	39.6	35	-22.8	TRUE	-36.53846154
q76-v2.4	q76-v2.4	11.9	100	13.2	100	1.3	TRUE	10.92436975
q77-v2.4	q77-v2.4	13.7	100	4.5	100	-9.2	TRUE	-67.15328467
q78-v2.4	q78-v2.4	170	100	159	100	-11	TRUE	-6.470588235

q79-v2.4	q79-v2.4	16	100	8.5	100	-7.5	TRUE	-46.875
q80-v2.4	q80-v2.4	49.3	100	36.6	100	-12.7	TRUE	-25.76064909
q81-v2.4	q81-v2.4	18.1	100	15.2	100	-2.9	TRUE	-16.02209945
q82-v2.4	q82-v2.4	18.5	19	17.9	19	-0.6	TRUE	-3.243243243
q83-v2.4	q83-v2.4	4.5	100	4.6	100	0.1	TRUE	0
q84-v2.4	q84-v2.4	NULL	0	NULL	0	0	TRUE	0
q85-v2.4	q85-v2.4	12.9	65	13.6	65	0.7	TRUE	5.426356589
q86-v2.4	q86-v2.4	6.8	100	5.6	100	-1.2	TRUE	-17.647058882
q87-v2.4	q87-v2.4	55.3	1	49.3	1	-6	TRUE	-10.849909958
q88-v2.4	q88-v2.4	47.6	1	40.4	1	-7.2	TRUE	-15.126055042
q89-v2.4	q89-v2.4	10.9	100	5.2	100	-5.7	TRUE	-52.293577798
q90-v2.4	q90-v2.4	3.4	1	3.6	1	0.2	TRUE	5.882352941

q91-v2.4	q91-v2.4	16.6	46	3.8	46	-12.8	TRUE	-77.10843373
q92-v2.4	q92-v2.4	4.8	1	1.5	1	-3.3	TRUE	-68.75
q93-v2.4	q93-v2.4	202.6	100	202.8	100	0.2	TRUE	0.09871668312
q94-v2.4	q94-v2.4	24.5	1	22.6	1	-1.9	TRUE	-7.755102041
q95-v2.4	q95-v2.4	95.8	1	96.8	1	1	TRUE	1.043841336
q96-v2.4	q96-v2.4	6.4	1	5.8	1	-0.6	TRUE	-9.375
q97-v2.4	q97-v2.4	69.2	1	63	1	-6.2	TRUE	-8.959537572
q98-v2.4	q98-v2.4	11.1	49294	3.2	49294	-7.9	TRUE	-71.171171117
q99-v2.4	q99-v2.4	14.5	100	10.4	100	-4.1	TRUE	-28.276586207
ss_max-v2.4	ss_max-v2.4	22	1	22.2	1	0.2	TRUE	0.909090909091
		4328.3		3752.4		-575.9		

					% improvement	13.3054548		

The following chart (to be inserted) will illustrate total runtime comparison for each dataset size.

Dataset Scale	System	Total Runtime	Improvement
1TB	Apache Spark	(baseline)	—
1TB	TabbyDB	(baseline × 0.87)	**+13%**
2TB	Apache Spark	(baseline)	—
2TB	TabbyDB	(baseline × 0.87)	**+13%**

These improvements are designed to maintain full compatibility with Spark APIs while providing measurable acceleration for complex analytical workloads.

Conclusion

The benchmark demonstrates that **TabbyDB delivers consistent, measurable performance gains** for analytic workloads on Apache Spark environments even in case of unpartitioned tables.. On realistic TPC-DS datasets and a moderate 6-node AWS cluster, TabbyDB achieved a **13% overall improvement** in runtime efficiency, validating its impact on real-world query performance.

For organizations running large-scale Spark workloads, TabbyDB provides a drop-in path to higher throughput and faster time-to-insight — without requiring query or code changes.