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MobilityDB: A Mainstream Moving Object Database System

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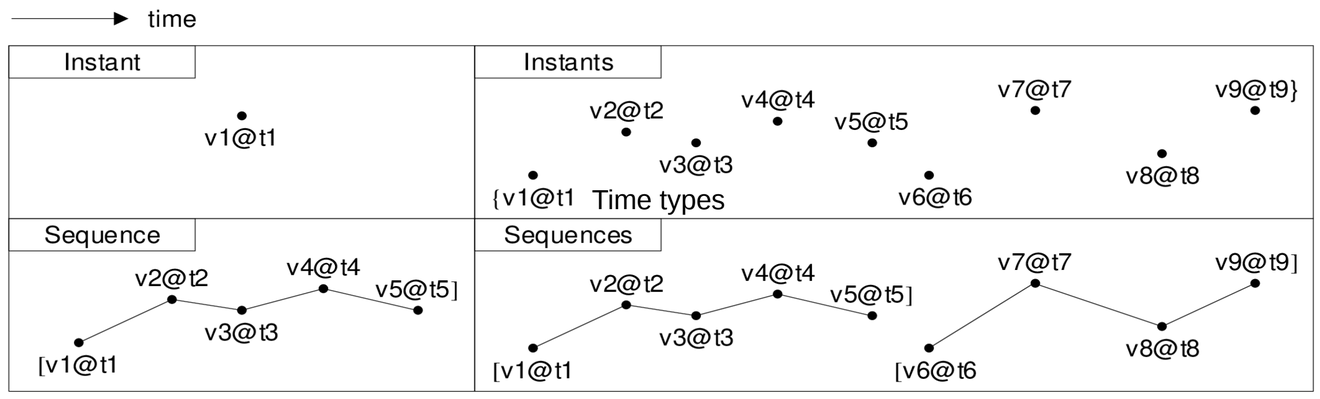
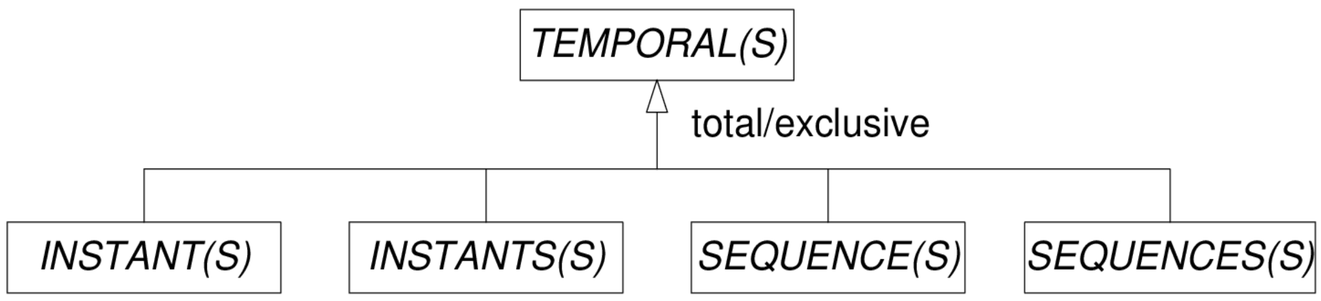
MobilityDB

It is an extensive MOD implementation on top of PostgreSQL and PostGIS with multiple novel aspects. MobilityDB features:

- Spatiotemporal types for moving geometry and geography points.
- Temporal integers, reals, Booleans, and strings.
- A rich set of operations on these types.
- The types are supported with spatiotemporal index access methods by extending GiST (Generalized Search Tree) and SP-GiST (Space Partitioning GiST).
- The query interface is SQL.
- MobilityDB thus extends the PostgreSQL optimizer with statistics collectors and selectivity estimation functions.
- It is available as open source.
- It integrates well with the PostgreSQL eco-system (e.g., Citus, PipelineDB).
- MobilityDB aims at implementing the OGC standard of Moving Features.



Time types




```
CREATE TABLE User (
    id int, checkIns tgeompoint(instants, 4326),
    numFriends tint(sequence),
    Trajectories tgeompoint(sequences, 4326) );
```

Q. 4 Which vehicles have passed the points from Points?

```
1  SELECT DISTINCT P.PointId, P.geom, T.CarId
2  FROM Trips T, Points P
3  WHERE st_intersects(trajectory(T.Trip), P.geom)
4  ORDER BY P.PointId, T.CarId
```

Q.10 List the minimum temporal distance between pairs of cars that ever come closer than 100 meters to one another.

```
1  SELECT T1.CarId AS Car1Id, T2.CarId AS Car2Id,
2      tmin(distance(T1.Trip, T2.Trip )) AS MinDistance
3  FROM Trips T1, Trips100 T2
4  WHERE T1.CarId < T2.CarId
5    AND tdwithin(T1.Trip, T2.Trip, 100.0) &= true
6    AND T1.Trip && expandSpatial(T2.Trip, 100)
7  GROUP BY T1.CarId, T2.CarId
```

```
1  GroupAggregate
2    Group Key: t1.carid, t2.carid"
3    -> Sort
4      Sort Key: t1.carid, t2.carid"
5      Sort Method: quicksort
6      -> Nested Loop
7        -> Seq Scan on trips100 t2
8        -> Index Scan using trips_spgist_idx on trips t1
9          Index Cond: (trip && expandspatial(t2.trip, 100))
10         Filter: ((carid < t2.carid) AND
11             (tdwithin(trip, t2.trip, 100) &= true))
```

Q. 8 What are the overall traveled distances of the vehicles with license plate numbers from QueryLicences1 during the periods from QueryPeriods1?

```
1  SELECT L.Licence, P.PeriodId, P.Period,
2      SUM(length(atPeriod(T.Trip, P.Period))) AS Dist
3  FROM Trips T, Licences1 L, Periods1 P
4  WHERE T.CarId = L.CarId AND T.Trip && P.Period
5  GROUP BY L.Licence, P.PeriodId, P.Period
6  ORDER BY L.Licence, P.PeriodId
```

Q. 17 Which points from Points have been visited by a maximum number of different vehicles?

```
1  WITH PointCount AS (
2      SELECT P.PointId, COUNT(DISTINCT T.CarId) AS Hits
3      FROM Trips T, Points P
4      WHERE st_intersects( trajectory( T.Trip ), P.geom )
5      GROUP BY P.PointId )
6  SELECT PointId, Hits
7  FROM PointCount AS P
8  WHERE P.Hits = ( SELECT MAX(Hits) FROM Point Count )
```

MobilityDB Cloud		MobilityDB Distributed	MobilityDB Python	MobilityDB JDBC
MobilityDB MapMatch		MobilityDB ETL	MobilityDB Stream	MobilityDB View
Citus	MobilityDB Network	MobilityDB	Psycopg 2.8	PostgreSQL JDBC 42.2.6
PostgreSQL 11/ PostGIS 2.5		Python 3.7		Java 11
Ubuntu 18.04.2 LTS				

Benchmark

- 17 BerlinMOD/R queries V.S. SECONDO, 4 data sets.
- MobilityDB came faster in 43 out of 68 queries.
- Total runtime:
  - MobilityDB 1700 seconds,
  - MobilityDB partitioned 1590 seconds,
  - and SECONDO 11900 seconds.

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