

Outline

1. What is a Query? Query Language?
2. Example Database Tables
3. SQL Overview: 3 Components
4. SELECT statement with 1 table
5. Multi-table SELECT statements
6. Why spatial extensions are needed?
7. 1-table spatial queries
8. Multi-table spatial queries
9. Trends



Learning Objectives

- After this segment, students will be able to
 - Recognize simple spatial data types and operations
 - Recognize concepts from OGIS simple features library
 - Determine output of a simple SQL/OGIS query (without spatial join)



Extending SQL for Spatial Data: New

- SQL 3 allows user-defined data types and operations
 - Spatial data types and operations can be added
- Open Geodata Interchange Standard (OGIS)
 - Half a dozen spatial data types
 - Over a dozen spatial operations
 - Supported by major vendors, e.g. ESRI, Intergraph, Oracle, IBM,...



OGIS Spatial Data Model

- Base-class:
 - Geometry
- Four sub-classes:
 - Point
 - Curve, e.g., LineString
 - Surface, e.g., Polygon
 - GeometryCollection
 - PointCollection, PolygonCollection, LineStringCollection



OGIS Spatial Data Model: Operations

- Three Categories of Operations
 - Apply to all geometry types
 - SpatialReference, Envelope, Export, IsSimple, Boundary
 - Predicates for Topological relationships
 - Equal, Disjoint, Intersect, Touch, Cross, Within, Contains
 - Spatial Data Analysis
 - Distance, Buffer, Union, Intersection, ConvexHull, SymDiff

Spatial Operations: Exercise

Which topological operator is needed to report rectangles with $(0,0)$ as an inside point?

- a) Cross
- b) Equal
- c) Contains
- d) Touch
- e) Within

Spatial Queries with SQL/OGIS: General Information

- SQL3 and OGIS are supported by many vendors
- Syntax **differs from** vendor to vendor
- Readers may need to alter SQL/OGIS queries given in slide to make them run on specific products



Where is OGIS used within SQL?

- SQL Data Definition Language
 - Spatial data-types for columns in CREATE TABLE
- SQL Data Manipulation Language
 - Spatial operations with SELECT, INSERT, ...
- Scope of our discussion
 - Use of OGIS operations with SELECT statement
 - Via a set of examples

Simple SQL SELECT_FROM_WHERE Examples

- Spatial analysis operations
 - Unary operator: Area
 - Binary operator: Distance
- Next Video
 - Spatial-Join using Topological operations
 - Touch, Cross
 - Using both spatial analysis and topological operations
 - Buffer, overlap



Unary Spatial Operation Area()

Query: List the name, population, and **area** of each country listed in the Country table

```
SELECT C.Name, C.Pop, Area(C.Shape) AS "Area"  
FROM Country C
```

Note: This query uses spatial operation, Area()
in place of a column in SELECT clause.

Binary Spatial Operation: Distance()

Query: List the GDP and the distance of a country's capital city to the "Equator" for all countries.

```
SELECT Co.GDP, Distance(Point(0,Ci.Shape.y),Ci.Shape) AS "Distance"  
FROM Country Co, City Ci  
WHERE Co.Name = Ci.Country  
AND Ci.Capital ='Y'
```

Co. Name	Co. GDP	Dist-to-Eq (in Km).
Havana	16.9	2562
Washington, D.C.	8003	4324
Brasilia	1004	1756
Ottawa	658	5005
Mexico City	694.3	2161
Buenos Aires	348.2	3854

Spatial Operations: Exercise

Which topological operator is needed to list rivers flowing through Argentina?

- a) Cross
- b) Equal
- c) Contains
- d) Touch