



Relational Database Languages

Tuple relational calculus

- ALPHA (Codd, 1970s)
- QUEL (based on ALPHA)
- Datalog (rule-based, like PROLOG)

Domain relational calculus

- QBE (used in Access)



History of SQL

- Developed by IBM as SEQUEL in early 70s (Structured English Query Language)
- Renamed SQL (Structured Query Language)
- SQL-86 (ANSI, ISO)
- SQL-89
- SQL-92 (SQL2)
- SQL:1999 (SQL3)
- SQL 2003
- SQL 2006

Many different flavors of SQL:
sqlplus, SQLServer, MySQL, etc.

Here: Access (roughly corresponds to SQL-89)



DDL part of SQL

Creating (CREATE),
Modifying (ALTER), and
Removing (DROP)

Catalogs
Schemas
Relations (Tables)
Constraints
Domains



DML part of SQL

Retrieving (SELECT),
Inserting (INSERT),
Modifying (UPDATE), and
Removing (DELETE).



SELECT

Combination of select, and project operations.

Basic Syntax:

```
SELECT <attribute_list>  
FROM <table_list>  
WHERE <condition>;
```

Example:

```
SELECT      fname, address  
FROM        employee  
WHERE       sex = 'F' AND  
            salary > 30000;
```



SELECT * and empty WHERE

```
SELECT *  
FROM employee;
```

```
SELECT *  
FROM employee, department;
```

```
SELECT *  
FROM employee, department  
WHERE dno=dnumber;
```



SELECT Examples

Company

- List the SSNs of all managers
- List the names of all projects
- List the names of all employees working for the research department.
- List the names of all departments managed by somebody with a salary less than 30,000.
- List employees with names of dependents.
- List the salaries of all employees working in Houston.



SELECT Examples

Pine Valley Furniture

- List the names of all product lines
- List the states in which customers reside
- List all products and their finish
- List salespersons with their phone and fax numbers
- List products with a cherry finish
- What products belong to the 'Country Look' product line?
- Which salespeople work in the NorthWest territory?



Duplicates in SQL

Duplicates can occur if key attributes are not selected

SQL keeps duplicates, for several reasons:

- Cheaper to implement
(duplicate elimination is expensive)
- Duplicates might be required
(e.g., aggregate functions)

Removal of duplicates can be forced using DISTINCT

SELECT DISTINCT SELECT ALL

Example:
List the states in which customers reside (Pine Valley)



Renaming

If necessary we can rename relations or attributes:

```
SELECT fname AS First_Name
FROM employee;
```



```
SELECT d.dname, e.dlocation
FROM department AS d,
dept_locations AS e
WHERE d.dnumber = e.dnumber;
```



Renaming Examples

Company

- List the names of all employees in columns called First_Name, Last_Name
- List the names of all departments located in Houston.
- List the names of all employees supervised by Franklin Wong.
- List the names of all employees with the names of their supervisors.

Pine Valley

- List employees with supervisors
- List employees and their skills



Types in Access

Numbers: 1, 17, -20
Text: 'Pine Valley'
Currency: 125
Date/Time: #1/10/2005#



Comparisons

=	Equality
<	Less than
<=	Less than or equal
>	Greater than
>=	Greater than or equal
<> or !=	not equal (depends on system)
LIKE	Allows Wildcards
	* (any number of characters)
	? (single character)
	# (single digit)
	[a-z] (range of charactes)
	[#] (special character, here: #)



Operators

+	Addition (works for dates in Oracle/Access)
-	Subtraction (works for dates in Oracle/Access)
*	Multiplication
/	Division
&	Concatenation (for strings)



Functions (Access)

String type:	
Length(s)	Length of string s
Right(s,n), Left(s,n)	Last (first) n letters of string s
Rtrim(s), Ltrim(s)	Delete trailing (leading) spaces
Numeric type:	
Floor(x)	Round x down
Ceiling(x)	Round x up
Abs(x)	Absolute value of x
Mod(x,k)	Remainder of dividing x by k
Power(x,k)	x^k



Functions (Access)

Date/Time type:

Now()	Current date
DateDiff('d', d1, d2)	Number of days between d1 and d2
day(d)	Day of date d
month(d)	Month (1-12) of date d
monthname(d)	Name of month of date d
year(d)	Year of date d



Examples

Company:

- Full names of employees
- Managers who started before 1990
- Dependents who are not spouses
- List employees that are younger than 40
- Employees and their start dates (formatted)
- Employees and their salaries in Euros

Pine Valley:

- Products and prices with sales tax
- Number of days since order was placed
- Products that are less than \$350 with a 10% discount



Between and Ordering

For number types, ranges can be defined using BETWEEN.

```
SELECT *
FROM employee
WHERE salary BETWEEN 30000 and 40000;
```

The ORDER BY clauses allows ordered output

```
SELECT * FROM employee
ORDER BY lname, fname ASC, salary DESC;
```



SQL Examples (Company)

- Names and addresses of all employees working for the research department
- Names and addresses of all employees who do not work for the research department
- List project number, controlling department number, and department manager's last name, address, and birth date for all projects located in 'Stafford'
- List SSNs of managers with at least one dependent



SQL Examples (Pine Valley)

- List product descriptions, finishes and their product lines
- List salespeople and the territories they work in
- List customers that placed an order after 2003
- List all employees that can use a 12in band saw
- List all products ordered in order 1006, how many copies were ordered, and the subtotal for each product
- List all products that are tables
