

Lecture 10:

STRUCTURED QUERY LANGUAGE (SQL)

PART 1

Objectives

- ◆ Introduce the structured query language (SQL)
- ◆ Use simple and compound conditions in SQL
- ◆ Use computed fields in SQL
- ◆ Use built-in SQL functions
- ◆ Use subqueries in SQL
- ◆ Group records in SQL

Objectives (Con't)

- ◆ Join tables using SQL
- ◆ Perform union operations in SQL
- ◆ Use SQL to update database data
- ◆ Use an SQL query to create a table in a database

SQL (Structured Query Language)

- ◆ Provides users with the capability to query a relational database
- ◆ Must enter commands to obtain desired results
- ◆ Developed under the name SEQUEL at IBM

Table Creation

◆ SQL CREATE TABLE

- Used to describe layout of a table

◆ Typical restrictions placed by DBMS

- Names cannot exceed 18 characters
- Names must start with a letter
- Names can contain only letters, numbers, and underscores (_)
- Names cannot contain spaces

Typical Data Types

◆ INTEGER

- Numbers without a decimal point

◆ SMALLINT

- Uses less space than INTEGER

◆ DECIMAL(p,q)

- P number of digits; q number of decimal places

◆ CHAR(n)

- Character string n places long

◆ DATE

- Dates in DD-MON-YYYY or MM/DD/YYYY

Simple Retrieval

- ◆ SELECT-FROM-WHERE-- basic form of SQL retrieval command
- ◆ SELECT clause – lists fields that you wish to display
- ◆ FROM clause – lists table or tables that contain data to display in query results
- ◆ WHERE clause – optional section used to list any conditions to be applied to the data to retrieve

Figures 10.1-10.2: Simple Retrieval

Microsoft Access SQL view

Microsoft Access - [Query1 : Select Query]

File Edit View Insert Query Tools Window Help

SELECT clause

SELECT CustomerNum, CustomerName, Balance

Fields to include in the query results

FROM Customer

Command ends with a semicolon

SQL reserved words are written in uppercase letters

Table from which to select data

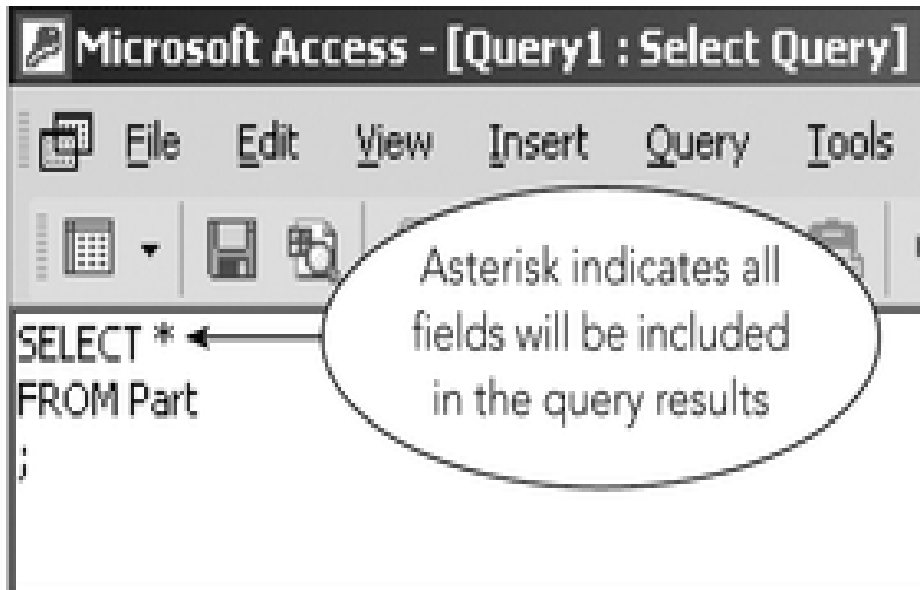
Fields in the SELECT clause appear in the same order in the results

Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

CustomerNum	CustomerName	Balance
48	AI's Appliance and Sport	\$6,550.00
282	Brookings Direct	\$431.50
356	Ferguson's	\$5,785.00
408	The Everything Shop	\$5,285.25
462	Bargains Galore	\$3,412.00
524	Kline's	\$12,762.00
608	Johnson's Department Store	\$2,106.00
687	Lee's Sport and Appliance	\$2,851.00
725	Deerfield's Four Seasons	\$248.00
842	All Season	\$8,221.00

All customer records are included in the query results



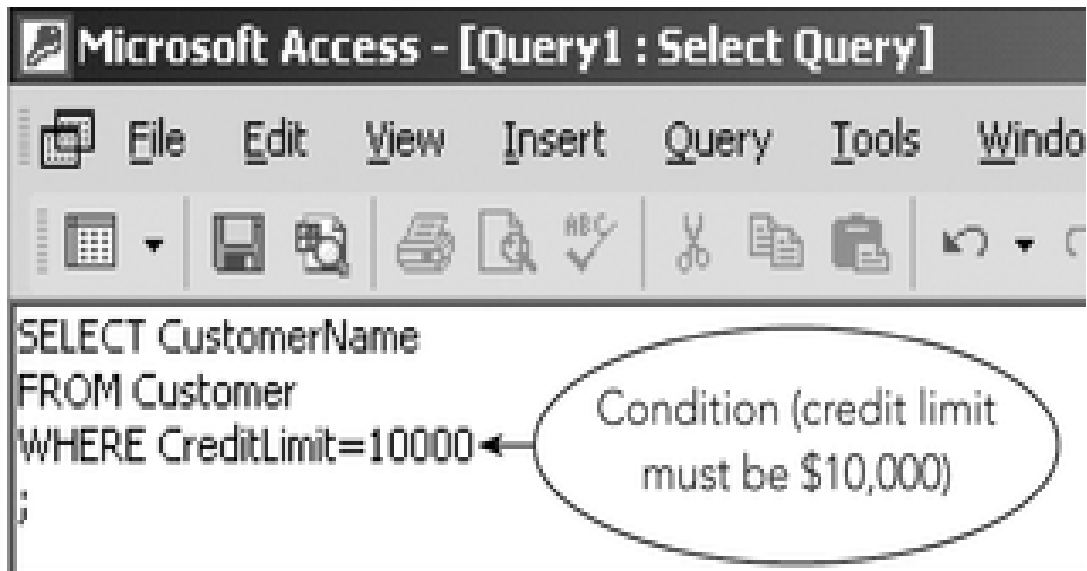
**Figures 10.3-10.4:
SQL Query to List Part Table**

Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

All fields are included

PartNum	Description	OnHand	Class	Warehouse	Price
AT94	Iron	50	HW	3	\$24.95
BV06	Home Gym	45	SG	2	\$794.95
CD52	Microwave Oven	32	AP	1	\$165.00
DL71	Cordless Drill	21	HW	3	\$129.95
DR93	Gas Range	8	AP	2	\$495.00
DW11	Washer	12	AP	3	\$399.99
FD21	Stand Mixer	22	HW	3	\$159.95
KL62	Dryer	12	AP	1	\$349.95
KT03	Dishwasher	8	AP	3	\$595.00
KV29	Treadmill	9	SG	2	\$1,390.00



Figures 10.5-10.6: SQL Query with Where Condition



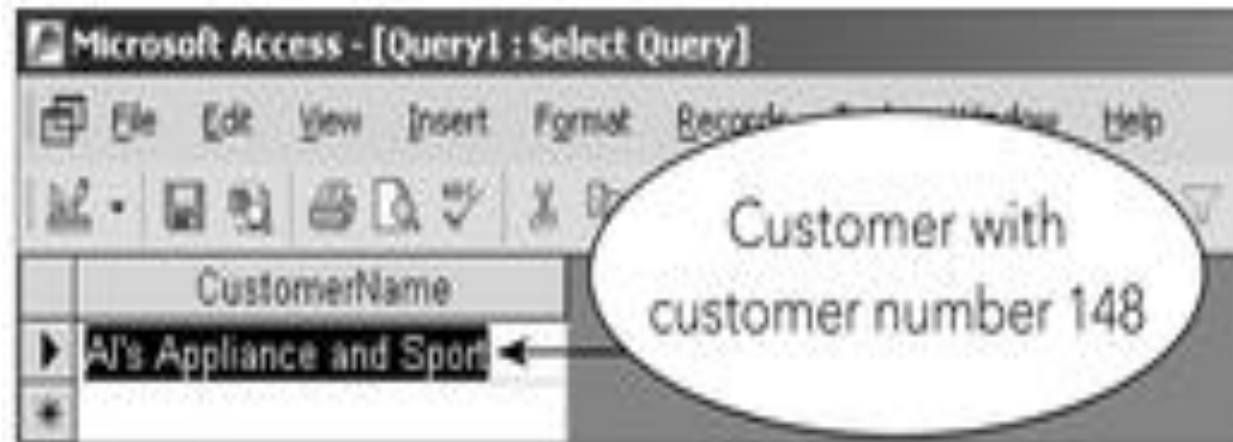
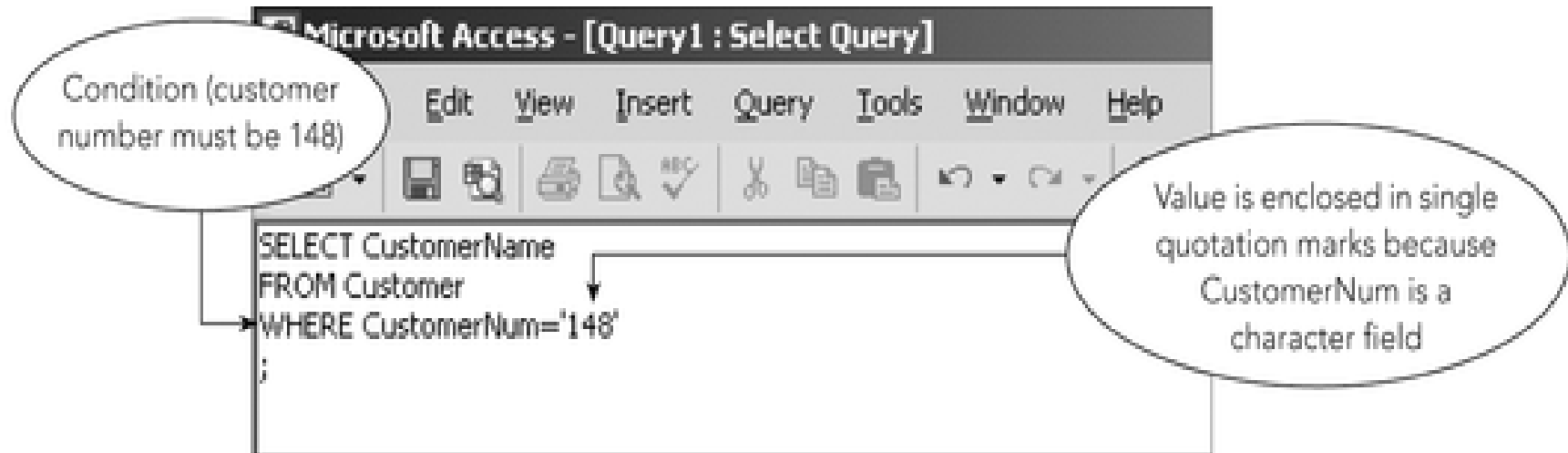
Simple Condition

- ◆ Includes the field name, comparison operator, and either another field or a value
- ◆ Two versions of the “not equal to” operator
 - < > and !=
- ◆ Use correct one for the version of SQL
- ◆ Using wrong version will generate an error

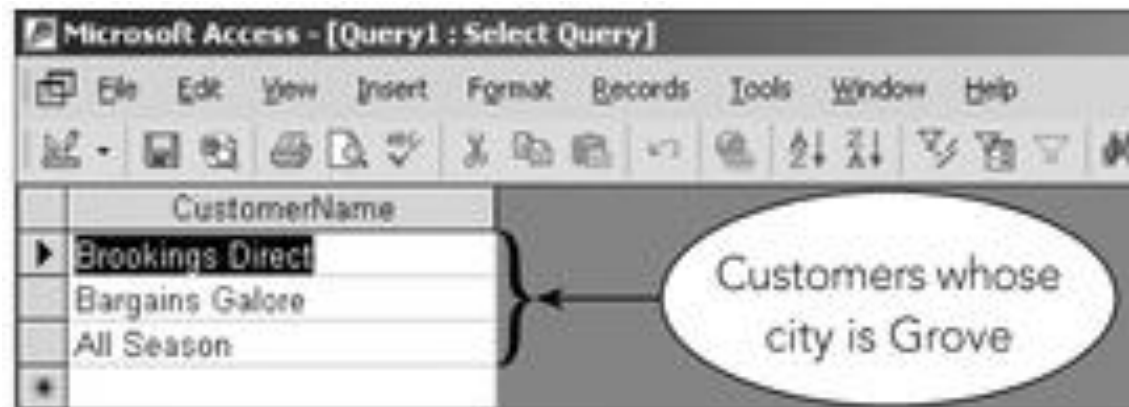
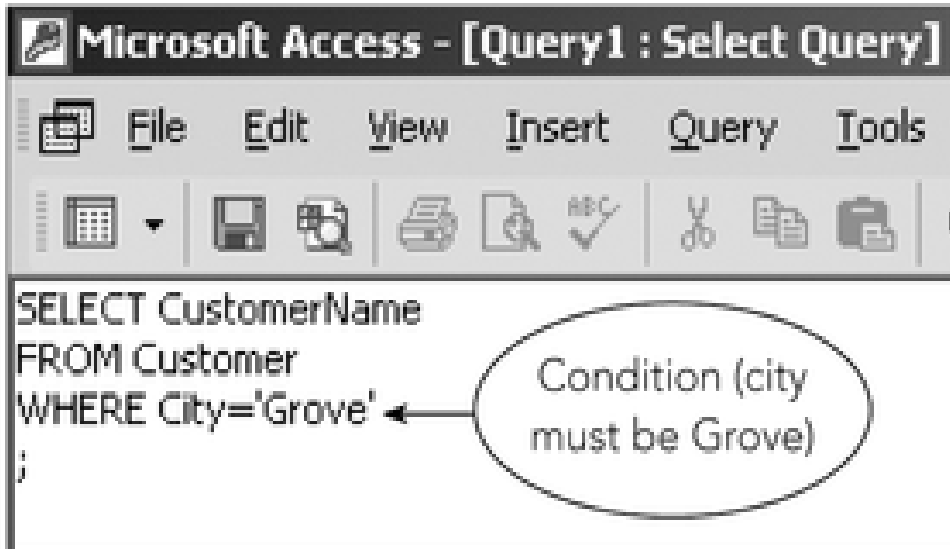
Figure 10.7: SQL Comparison Operators

Comparison Operator	Meaning
=	Equal to
<	Less than
>	Greater than
<=	Less than or equal to
>=	Greater than or equal to
< >	Not equal to (used by most implementations of SQL)
!=	Not equal to (used by some implementations of SQL)

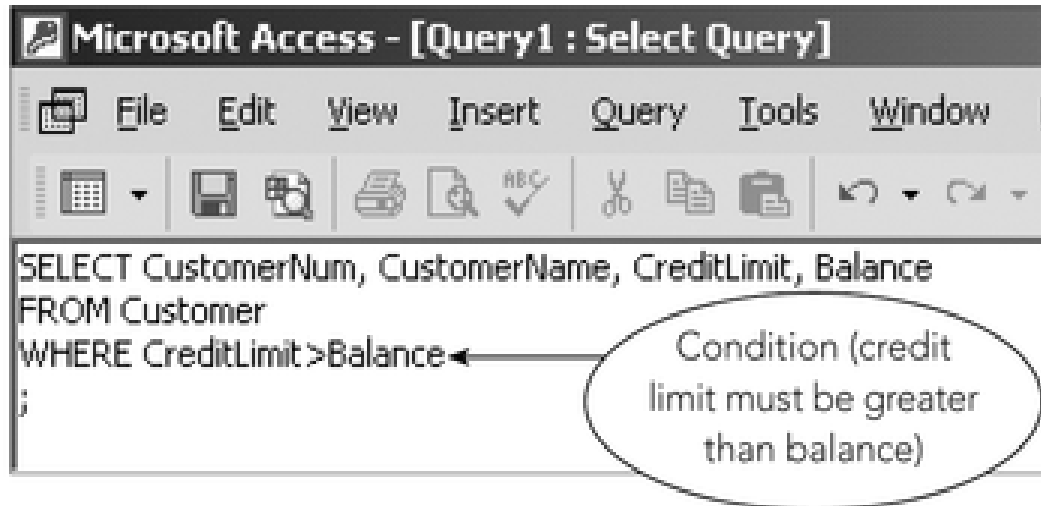
Figures 10.8-10.9: SQL Query to Find Customer 148



Figures 10.10-10.11: SQL Query to Find All Customers in 'Grove'



Figures 10.12-10.13: Query to find Customers with Credit Limit Exceeding Balance



Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

Type a question for help

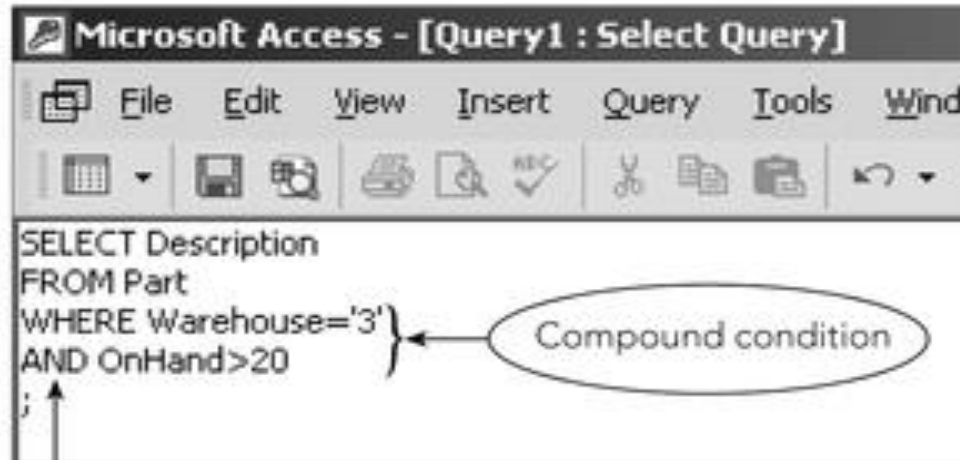
	CustomerNum	CustomerName	CreditLimit	Balance
▶	148	AI's Appliance and Sport	\$7,500.00	\$6,550.00
	282	Brookings Direct	\$10,000.00	\$431.50
	356	Feeguson's	\$7,500.00	\$5,785.00
	462	Bargains Galore	\$10,000.00	\$3,412.00
	524	Kline's	\$15,000.00	\$12,762.00
	608	Johnson's Department Store	\$10,000.00	\$2,106.00
	687	Lee's Sport and Appliance	\$5,000.00	\$2,851.00
	725	Deerfield's Four Seasons	\$7,500.00	\$248.00
*				

Customers whose credit limits are greater than their balances

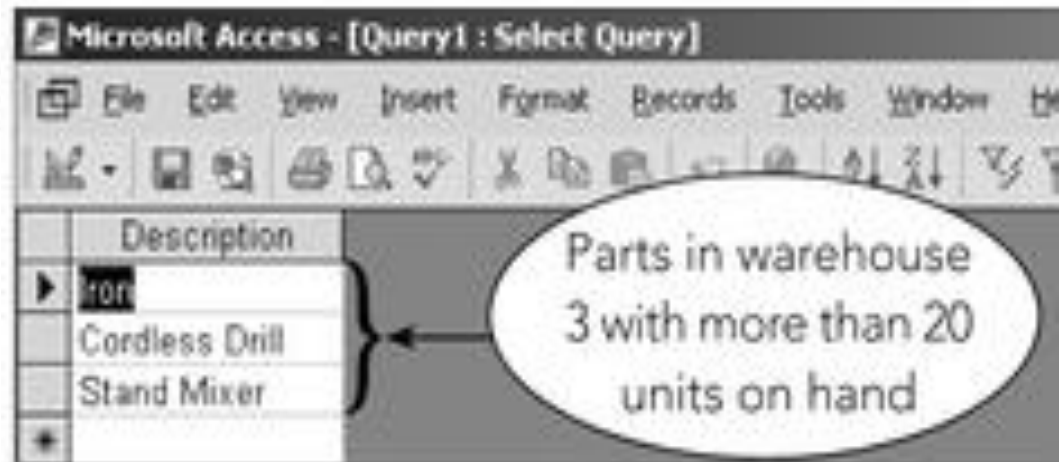
Compound Conditions

- ◆ Formed by connecting two or more simple conditions using one or both of the operators AND and OR
- ◆ Can also precede a single condition with NOT operator to negate a condition
- ◆ With AND all simple conditions must be true for the compound condition to be true
- ◆ With OR the compound condition will be true when any of the simple conditions are true

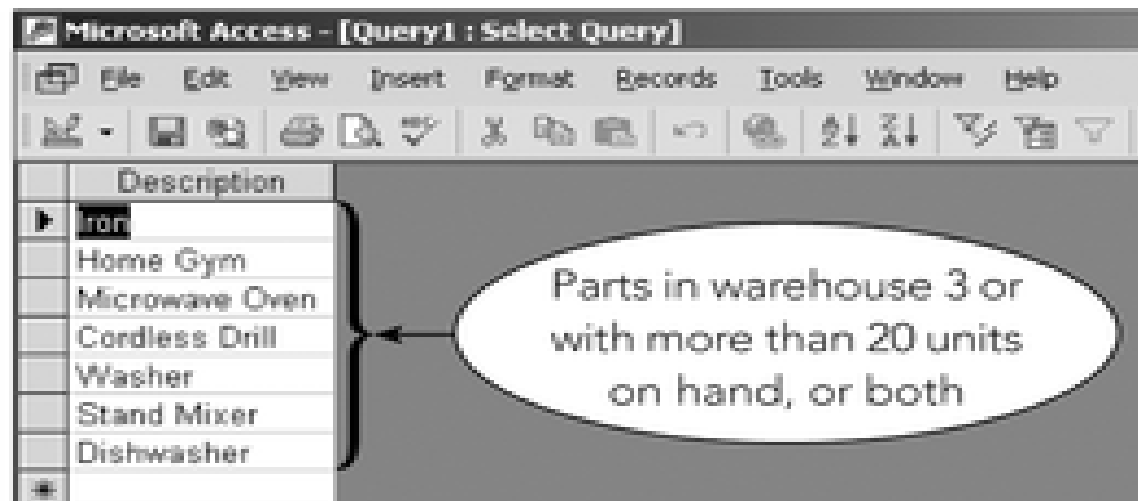
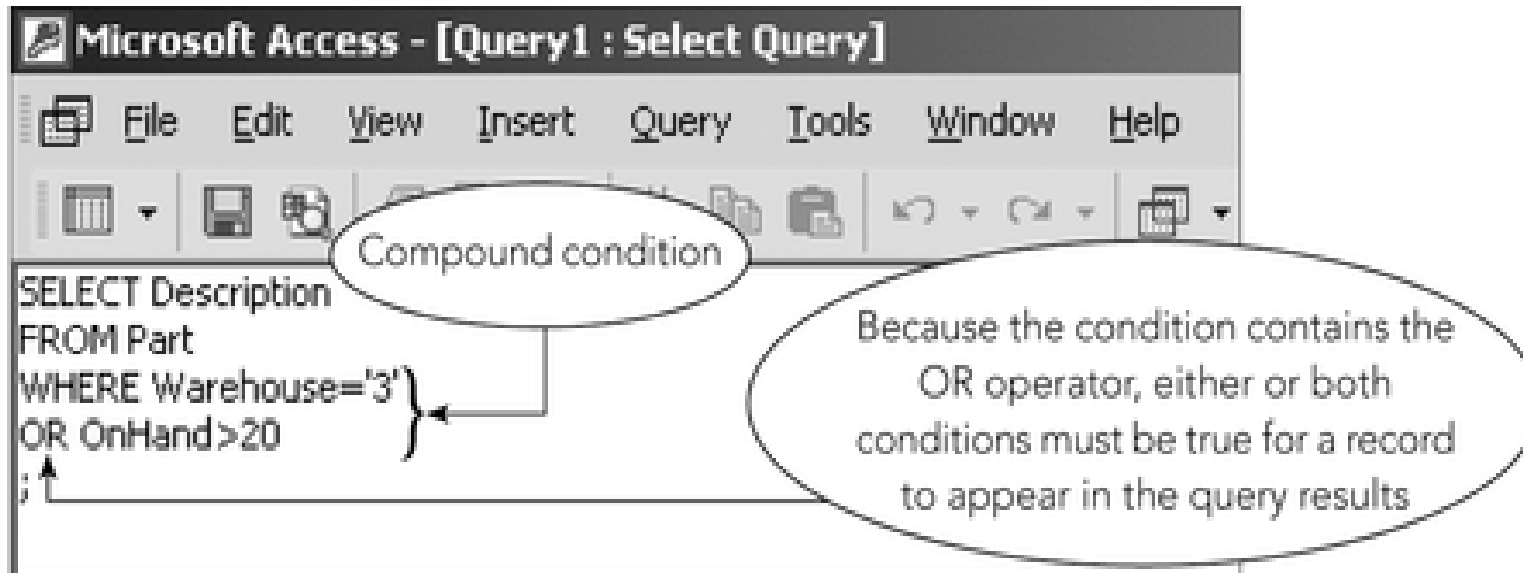
Figures 10.14-10.15: SQL Query with Compound Condition using 'AND'



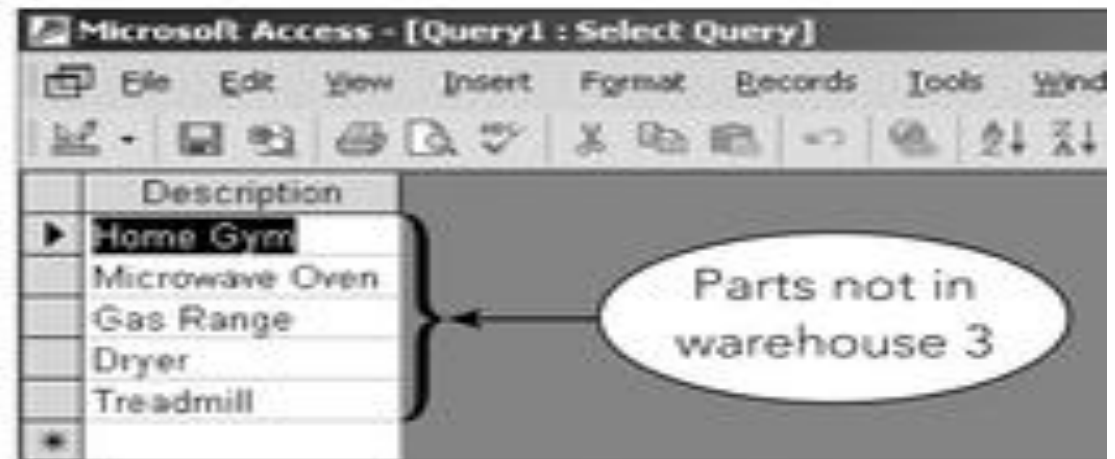
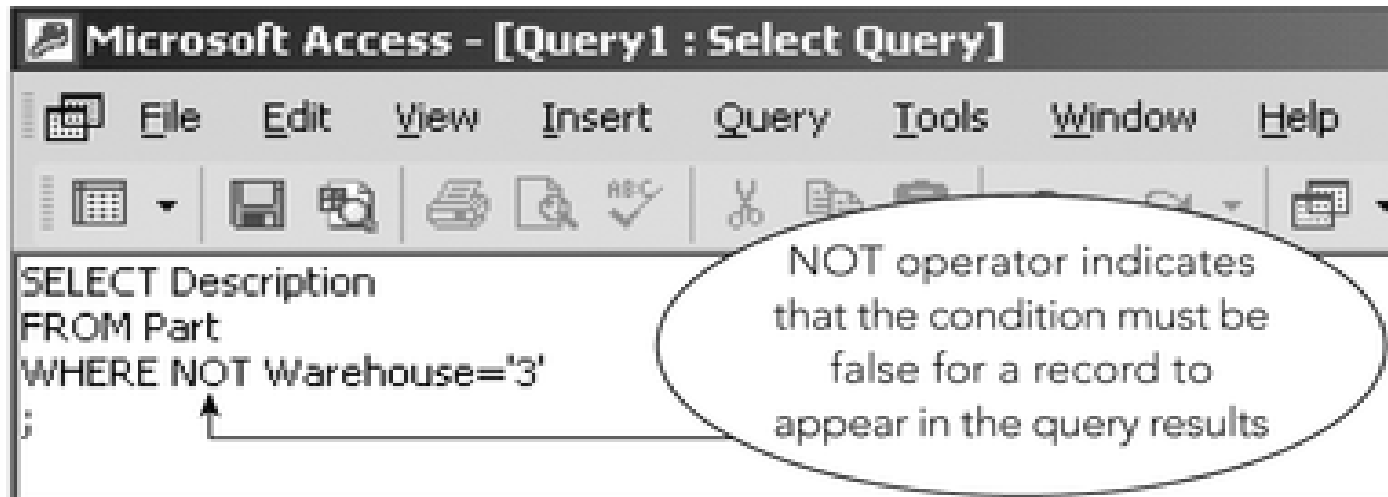
Because the condition contains the AND operator, both conditions must be true for a record to appear in the query results



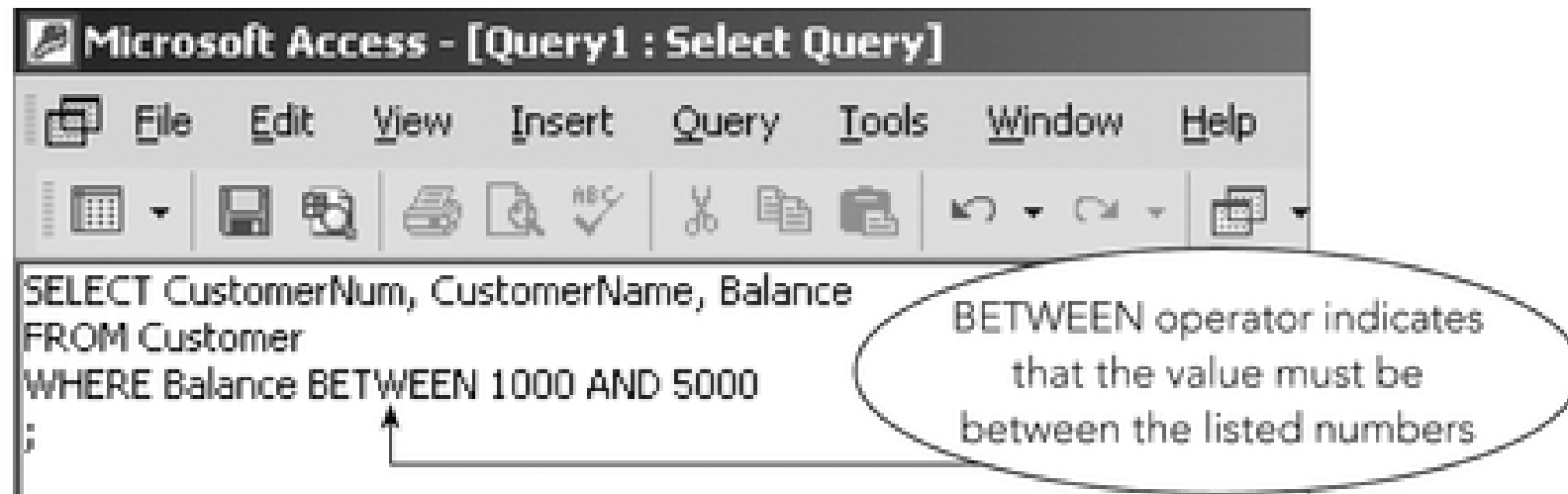
Figures 10.16-10.17: SQL Query using 'OR'



Figures 10.18-10.19: SQL Query using 'NOT'



Figures 10.20-10.21: Query with 'BETWEEN' Operator



Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

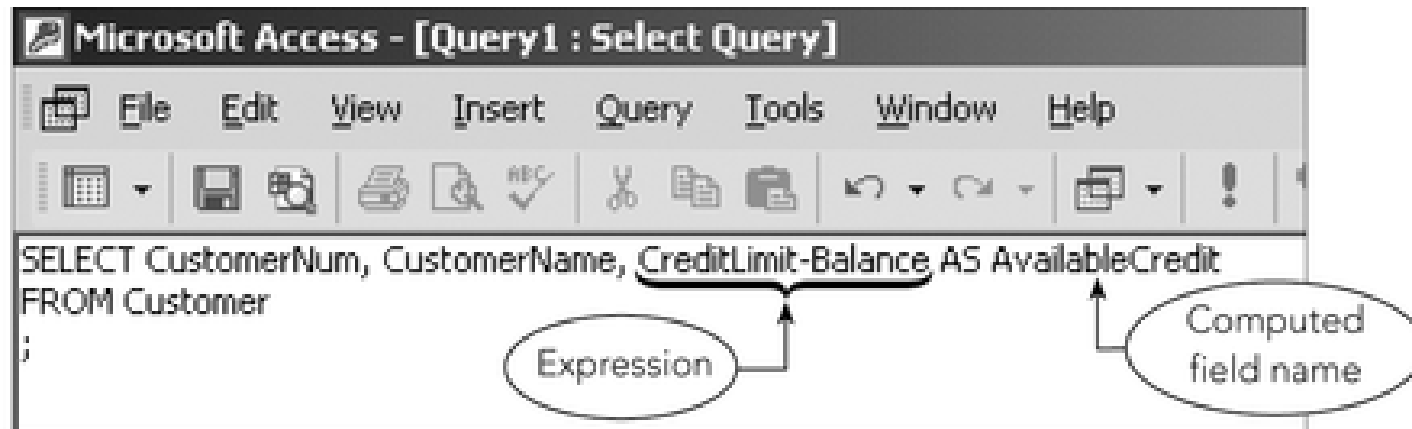
CustomerNum	CustomerName	Balance
462	Bargains Galore	\$3,412.00
608	Johnson's Department Store	\$2,106.00
687	Lee's Sport and Appliance	\$2,851.00
*		

Customers with balances between \$1,000 and \$5,000

Computed Fields

- ◆ Field whose values are derived from existing fields
- ◆ Computed fields can involve:
 - Addition (+)
 - Subtraction (-)
 - Multiplication (*)
 - Division (/)

Figures 10.22-10.23: SQL Query with Computed Field



Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

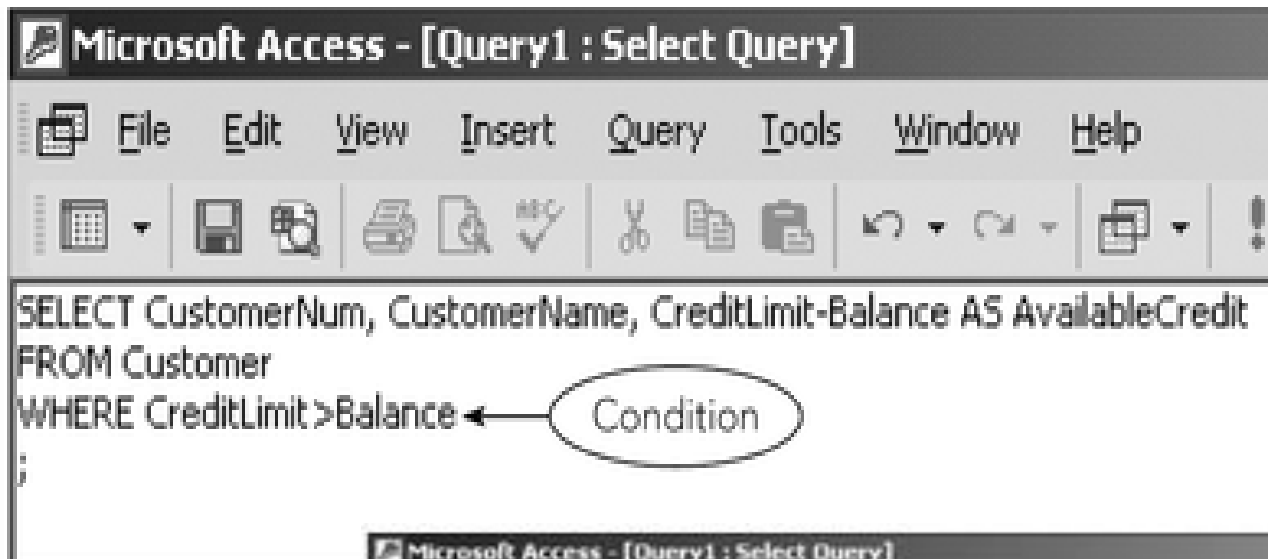
Type a question for help

CustomerNum	CustomerName	AvailableCredit
148	AI's Appliance and Sport	\$950.00
282	Brookings Direct	\$9,568.50
356	Ferguson's	\$1,715.00
408	The Everything Shop	(\$285.25)
462	Bargains Galore	\$6,588.00
524	Kline's	\$2,238.00
608	Johnson's Department Store	\$7,894.00
687	Lee's Sport and Appliance	\$2,149.00
725	Deerfield's Four Seasons	\$7,252.00
842	All Season	(\$721.00)

Available credit amounts

Computed field name

Figures 10.24-10.25: SQL Query with Computed Field and Condition



Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

Type a question for help

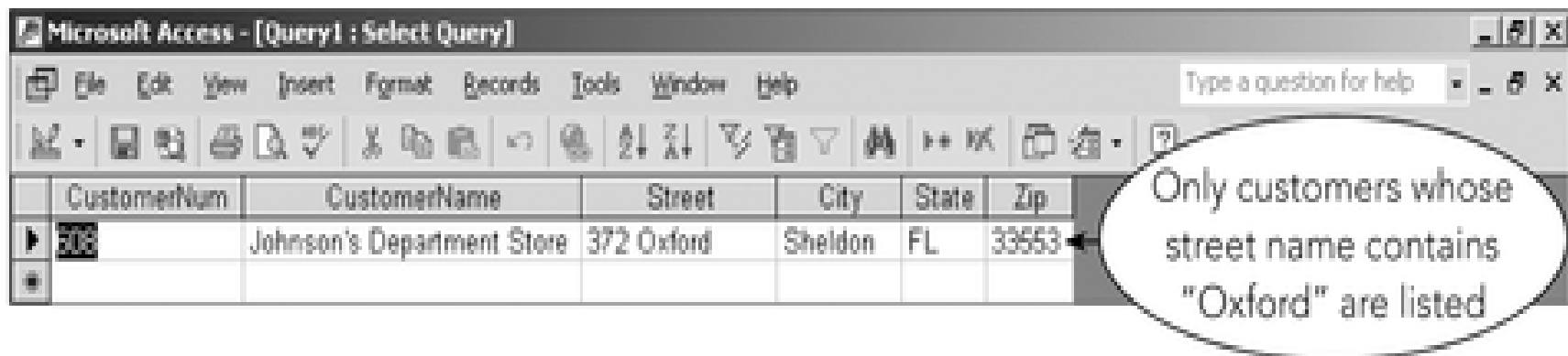
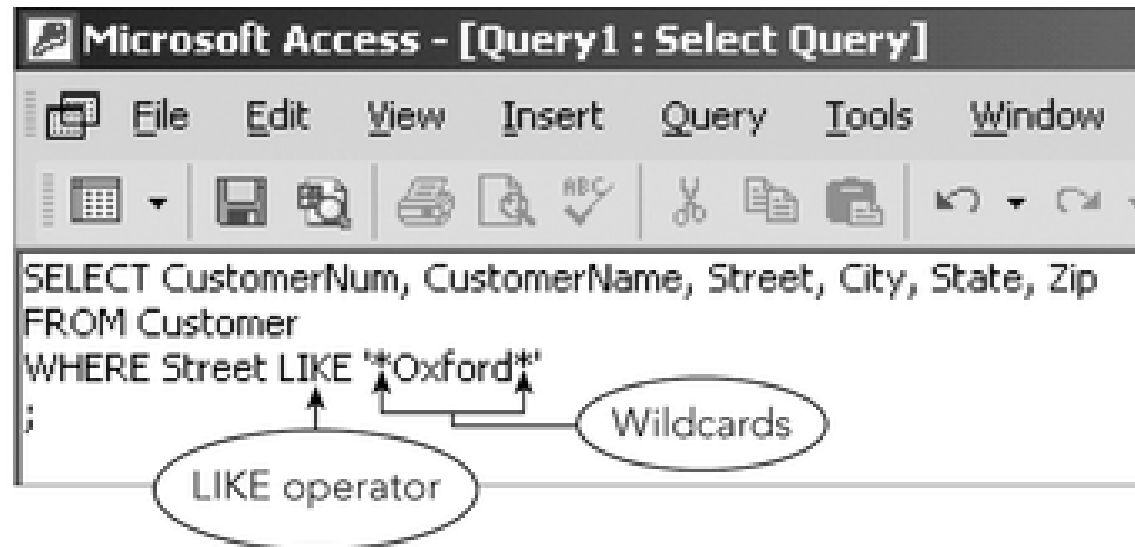
CustomerNum	CustomerName	AvailableCredit
148	AI's Appliance and Sport	\$950.00
282	Brookings Direct	\$9,568.50
356	Ferguson's	\$1,715.00
462	Bargains Galore	\$6,588.00
524	Kline's	\$2,238.00
608	Johnson's Department Store	\$7,894.00
687	Lee's Sport and Appliance	\$2,149.00
725	Deerfield's Four Seasons	\$7,252.00

Only customers with credit limits that exceed their balances are listed

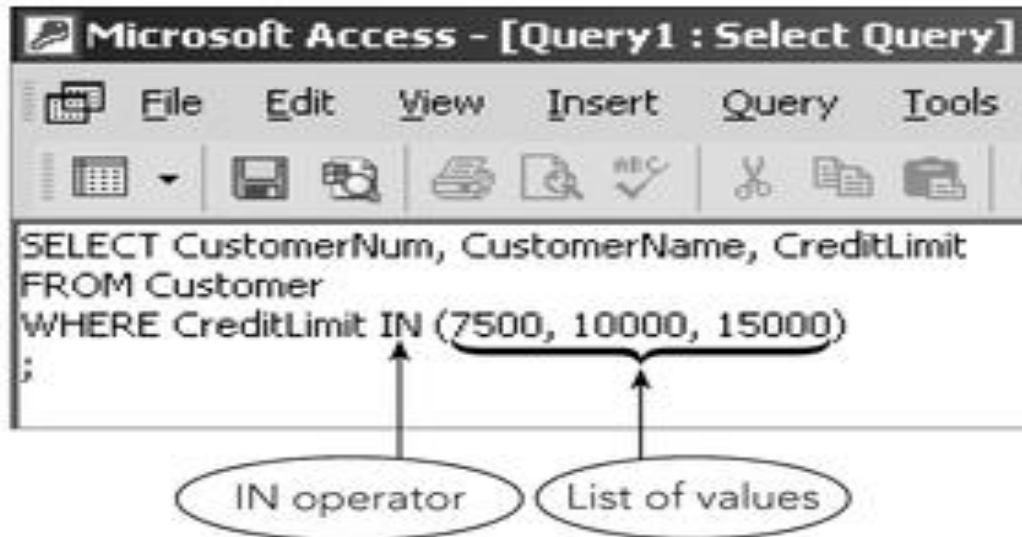
Special Operators and Sorting

- ◆ LIKE operator is used with a wildcard symbol to find non-exact matches
- ◆ IN operator provides a concise way of phrasing certain conditions
- ◆ ORDER BY clause is used to display results in desired order
- ◆ Sort key or key – field on which to sort data

Figures 10.26-10.27: SQL Query with 'LIKE' Operator



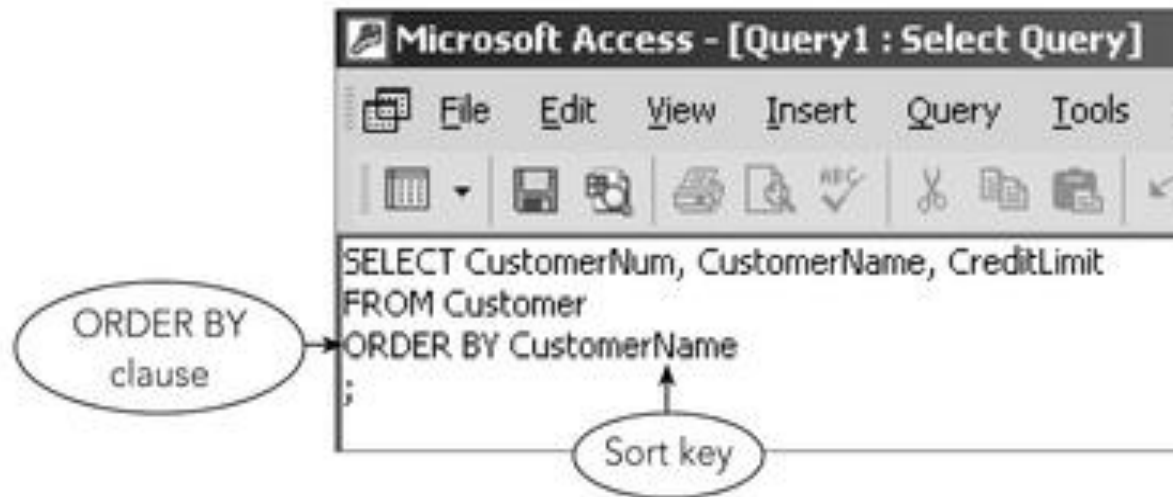
Figures 10.28-10.29: SQL Query with 'IN' Operator



The screenshot shows the Microsoft Access interface with the title bar "Microsoft Access - [Query1 : Select Query]". The menu bar includes File, Edit, View, Insert, Format, Records, Tools, Window, and Help. The data grid displays the results of the query, showing CustomerNum, CustomerName, and CreditLimit. A callout bubble indicates that only customers with credit limits of \$7,500, \$10,000, or \$15,000 are listed.

CustomerNum	CustomerName	CreditLimit
148	AI's Appliance and Sport	\$7,500.00
282	Brookings Direct	\$10,000.00
356	Ferguson's	\$7,500.00
462	Bargains Galore	\$10,000.00
524	Kline's	\$15,000.00
608	Johnson's Department Store	\$10,000.00
725	Deerfield's Four Seasons	\$7,500.00
842	All Season	\$7,500.00

Figures 10.30-10.31: SQL Query to Sort Data



Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

Type a question for

	CustomerNum	CustomerName	CreditLimit
▶	342	All Season	\$7,500.00
	148	AJ's Appliance and Sport	\$7,500.00
	462	Bargains Galore	\$10,000.00
	282	Brookings Direct	\$10,000.00
	725	Deerfield's Four Seasons	\$7,500.00
	356	Ferguson's	\$7,500.00
	608	Johnson's Department Store	\$10,000.00
	524	Kline's	\$15,000.00
	687	Lee's Sport and Appliance	\$5,000.00
	408	The Everything Shop	\$5,000.00
*			

Customers are sorted alphabetically by name

Figures 10.32-10.33: SQL Query to Sort on Multiple Fields

Microsoft Access - [Query1 : Select Query]

```
SELECT CustomerNum, CustomerName, CreditLimit
FROM Customer
ORDER BY CreditLimit DESC, CustomerName
;
```

Major (primary) sort key

Descending order

Minor (secondary) sort key

Within credit limit; customers are sorted by name

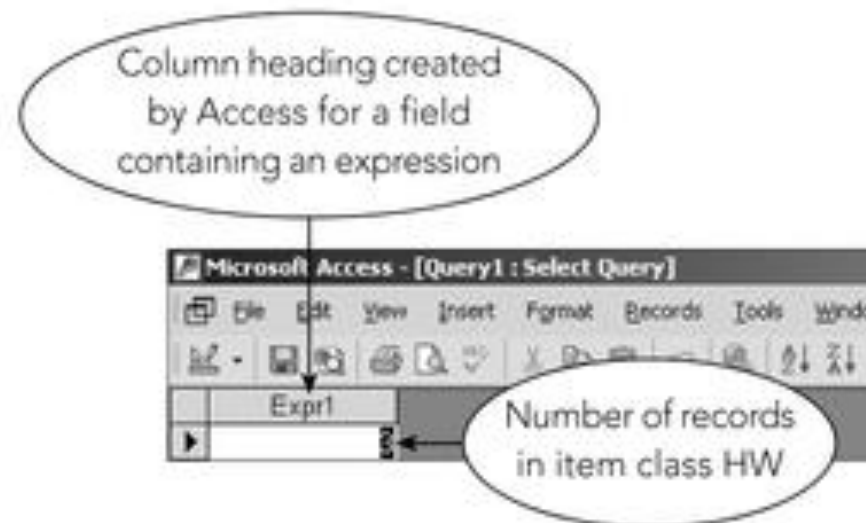
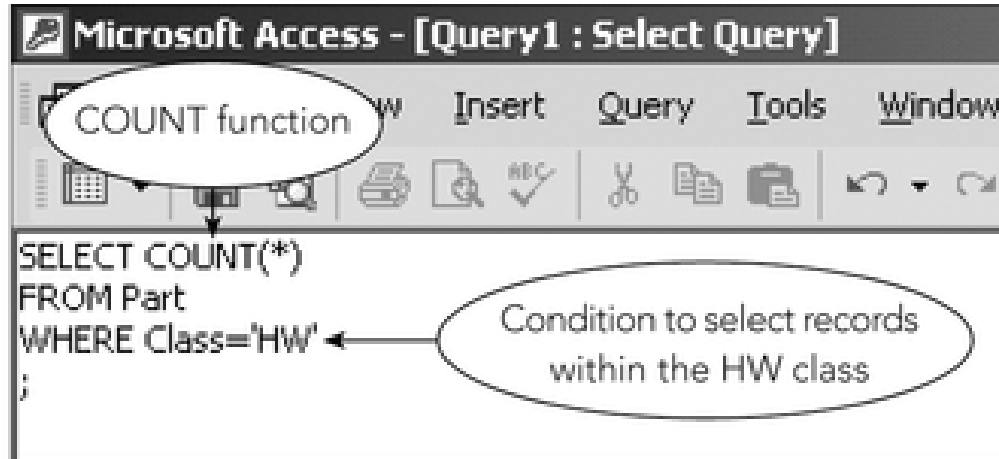
CustomerNum	CustomerName	CreditLimit
524	Kline's	\$15,000.00
462	Bargains Galore	\$10,000.00
262	Brookings Direct	\$10,000.00
608	Johnson's Department Store	\$10,000.00
842	All Season	\$7,500.00
148	Al's Appliance and Sport	\$7,500.00
725	Deerfield's Four Seasons	\$7,500.00
356	Ferguson's	\$7,500.00
687	Lee's Sport and Appliance	\$5,000.00
408	The Everything Shop	\$5,000.00

Customers are sorted by credit limit in descending order

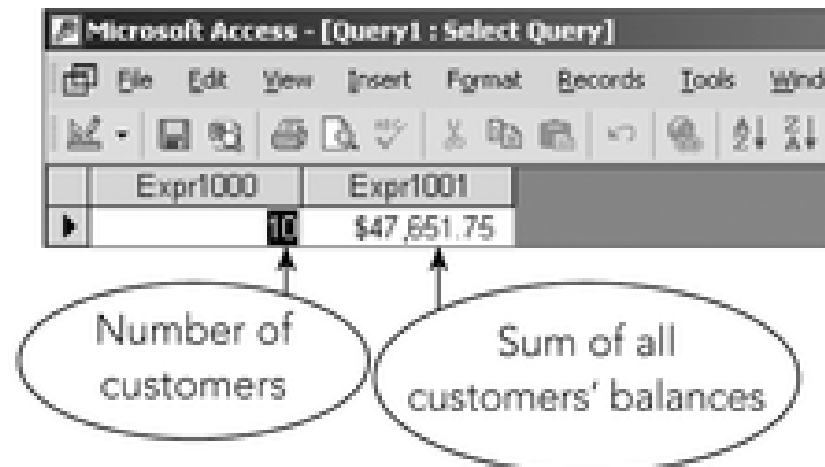
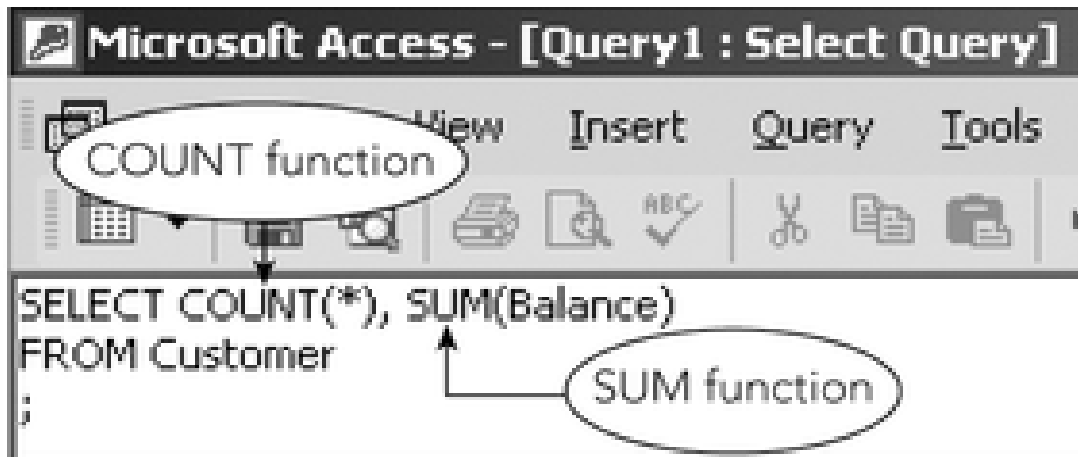
Built-In Functions

- ◆ Built-In functions (aggregate functions) are used to
 - COUNT - calculate number of entries
 - SUM or AVG – finds sum or average of all entries in a given column
 - MAX or MIN – finds largest or smallest values respectively

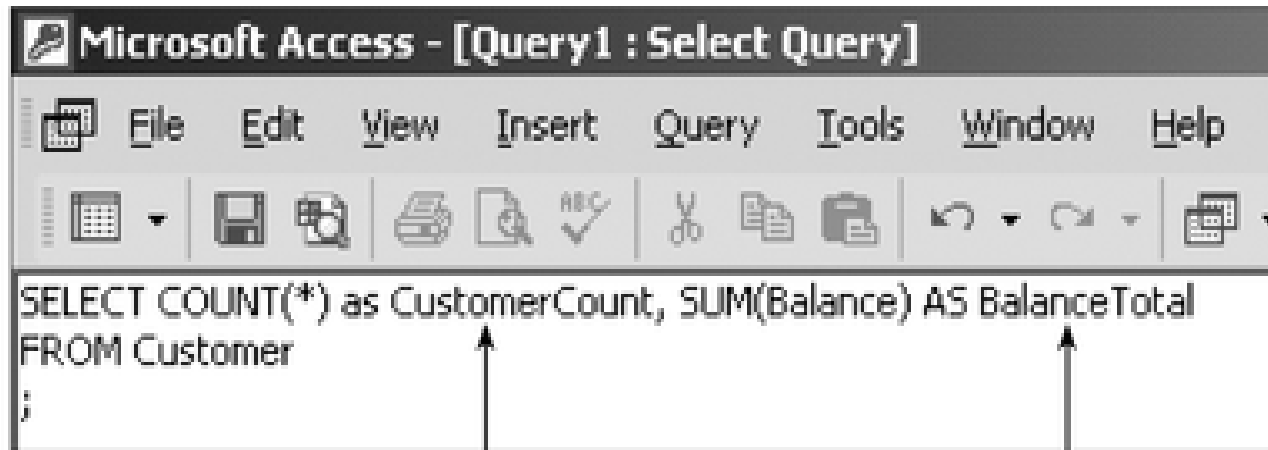
Figures 10.34-10.35: SQL Query to Count Records



Figures 10.36-10.37: SQL Query to Count Records and Calculate a Total



Figures 10.38-10.39: SQL Query to Perform Calculations and Rename Fields



Name for count
of customers

Name of sum
of balances

New field
names

Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Rec

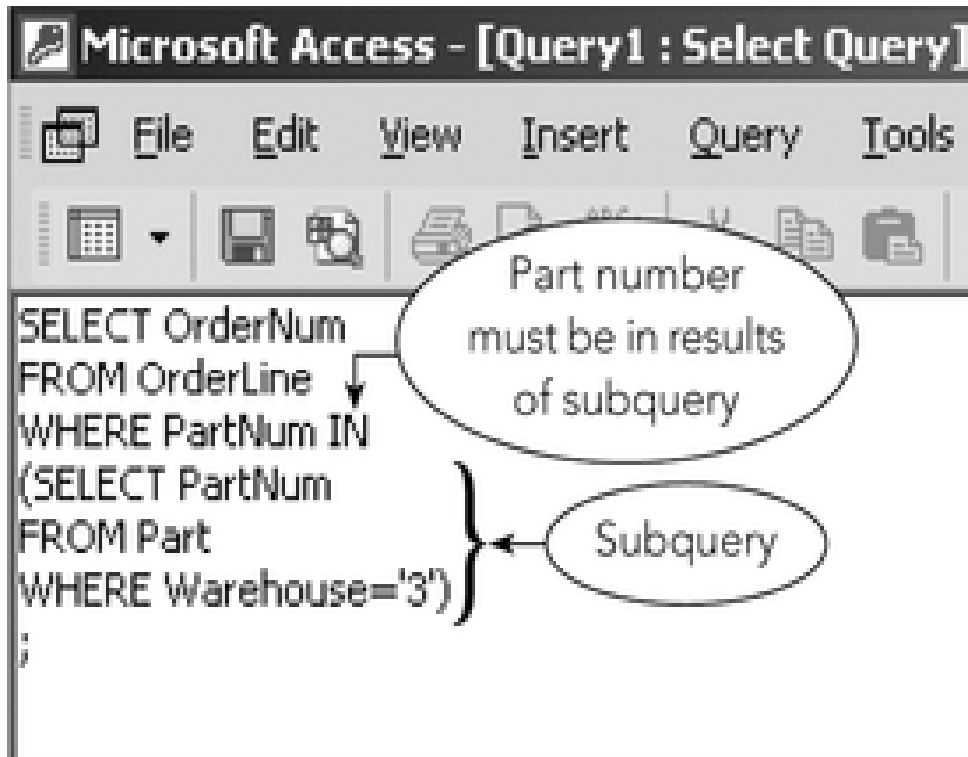
CustomerCount	BalanceTotal
10	\$47,651.75

This screenshot shows the same Microsoft Access interface, but the query results are displayed in Datasheet View. The results show a total of 10 customers with a total balance of \$47,651.75. The field names 'CustomerCount' and 'BalanceTotal' are visible in the header row.

Nesting Queries

- ◆ Nested query - place one query inside another
- ◆ Subquery – inner query
- ◆ Subquery is evaluated first
- ◆ Outer query is evaluated after the subquery

Figures 10.40-10.41: SQL Query with Subquery



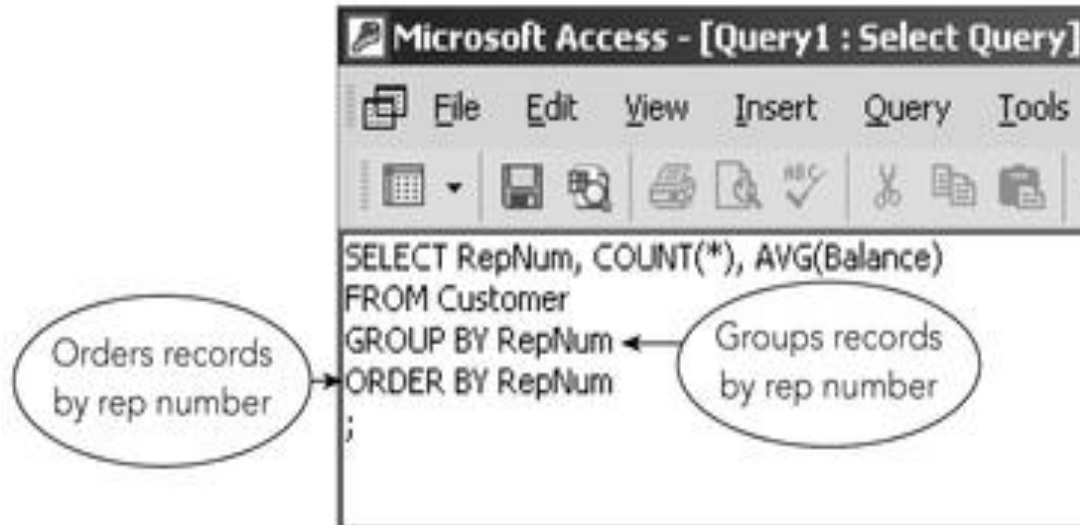
Microsoft Access - [Query1 : Select Query]

	OrderNum
▶	21608
	21610
	21614
+	

Grouping

- ◆ Means creating groups of records that share some common characteristic
- ◆ GROUP BY clause used to indicate grouping in SQL
- ◆ HAVING clause – is to groups what the WHERE clause is to rows

Figures 10.42-10.43: SQL Query to Group Records



Microsoft Access

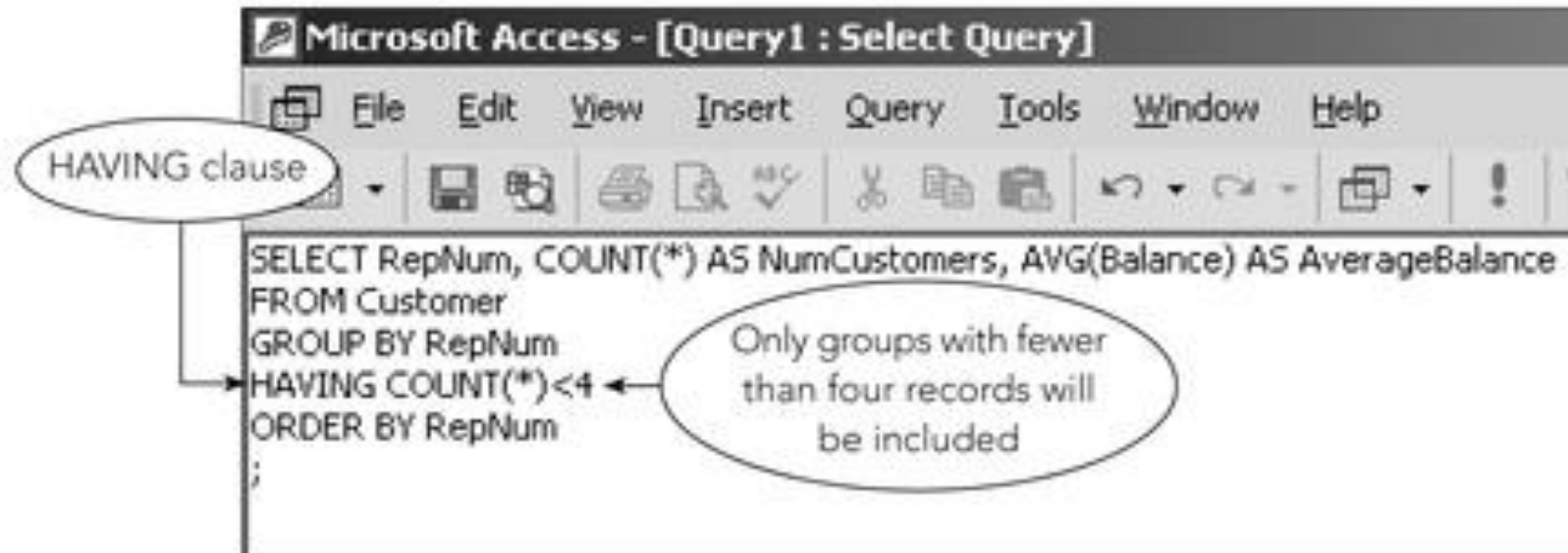
Rep 20

Number of customers of rep 20

Average balance of customers of rep 20

RepNum	Expr1001	Expr1002
20	3	\$9,177.67
35	4	\$2,203.94
65	3	\$3,767.67

Figures 10.44-10.45: SQL Query to Restrict Groups

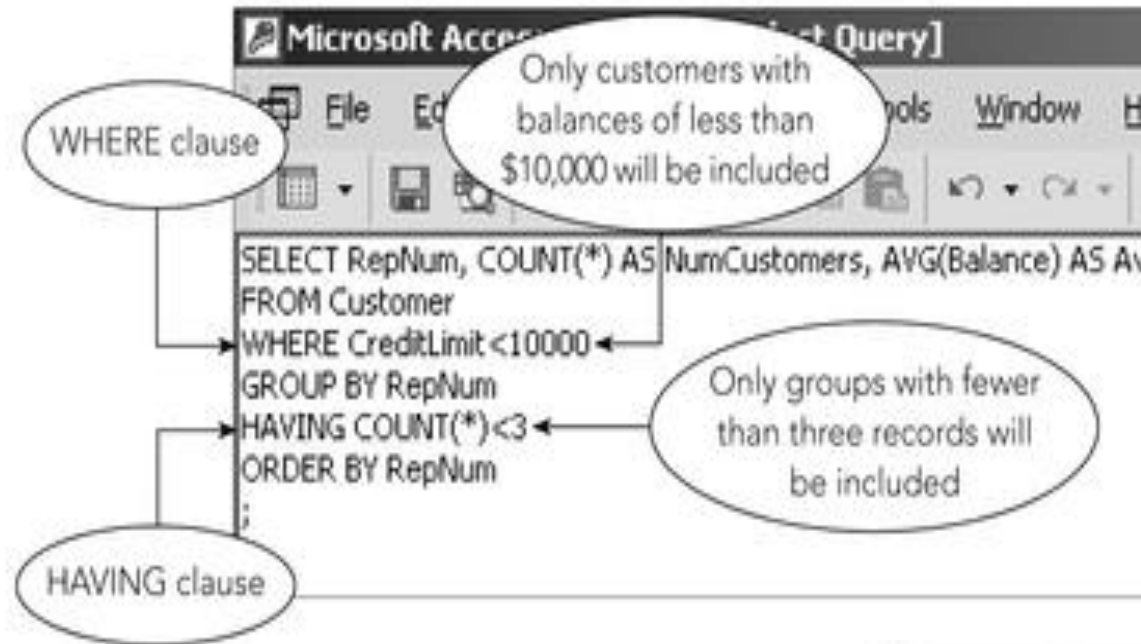


Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records

	RepNum	NumCustomers	AverageBalance
▶	60	3	\$9,177.67
	65	3	\$3,767.67

Figures 10.46-10.47: SQL Query with 'WHERE' and 'HAVING' Clauses



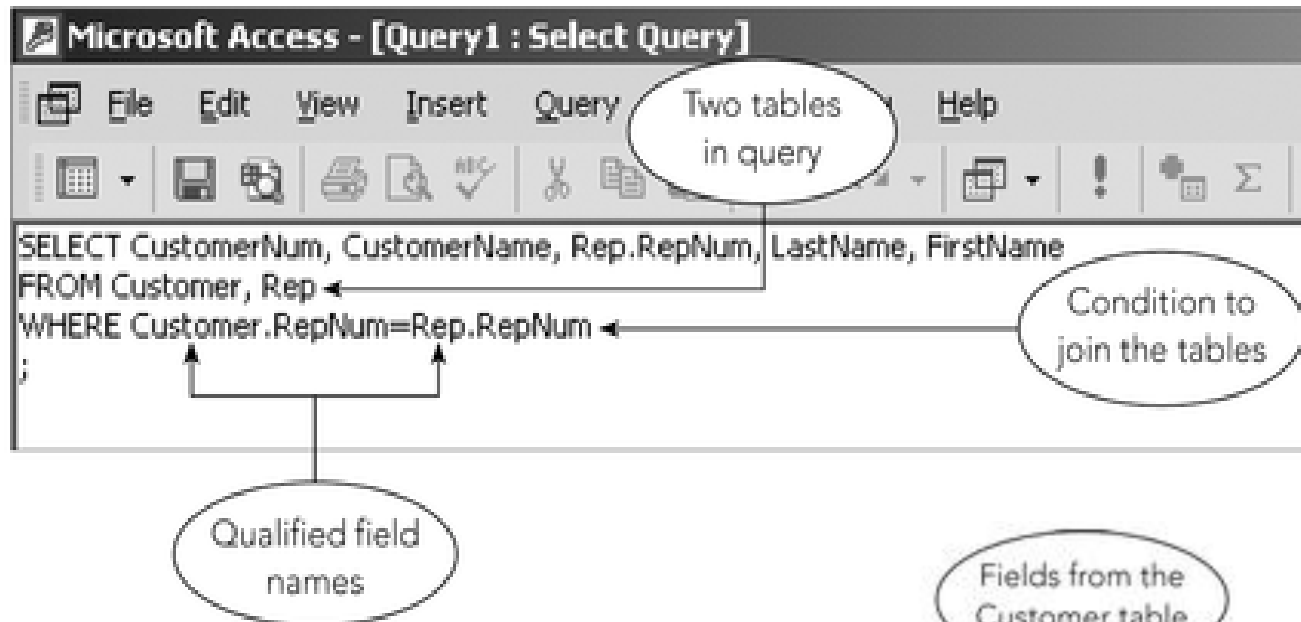
The screenshot shows the results of the query in a table view. The table has the following data:

RepNum	NumCustomers	AverageBalance
20	2	\$7,385.50
65	1	\$5,785.00

Joining Tables and Union

- ◆ Allow queries to locate data from more than one table
- ◆ Accomplished by entering the appropriate conditions in the WHERE clause
- ◆ Two tables involved in a union must have the same structure
 - Same number of fields
 - Corresponding fields must have same data types

Figures 10.48-10.49: SQL Query to Join Tables



Microsoft Access - [Query1 : Select Query]

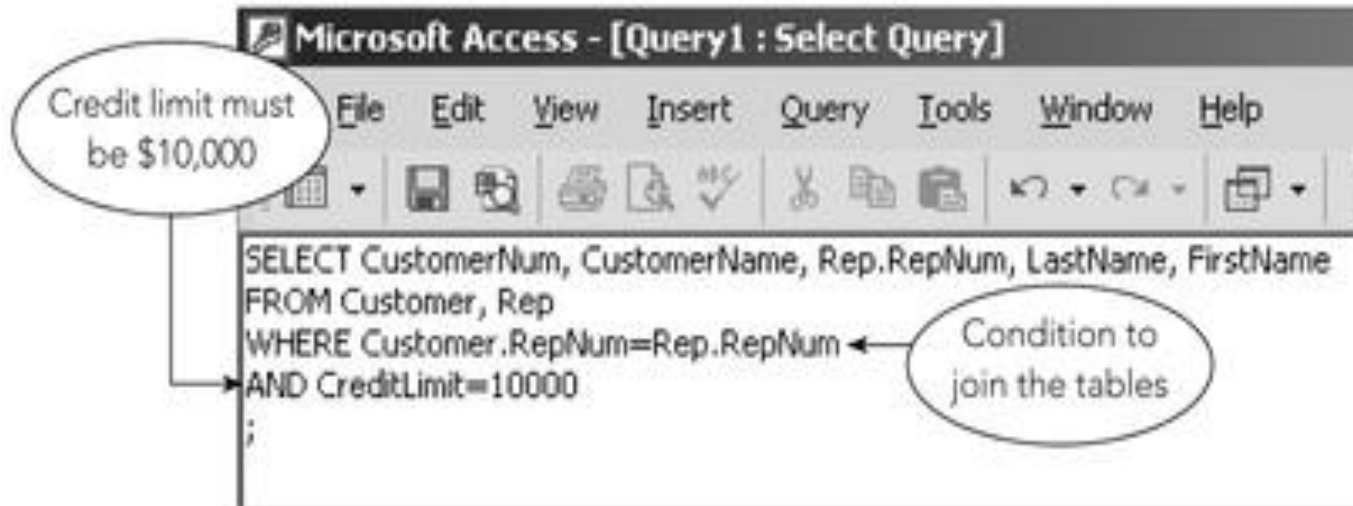
File Edit View Insert Format Records Tools Window Help

CustomerNum	CustomerName	RepNum	LastName	FirstName
148	Al's Appliance and Sport	20	Kaiser	Valerie
524	Kline's	20	Kaiser	Valerie
842	All Season	20	Kaiser	Valerie
282	Brookings Direct	35	Hull	Richard
408	The Everything Shop	35	Hull	Richard
687	Lee's Sport and Appliance	35	Hull	Richard
725	Deerfield's Four Seasons	35	Hull	Richard
356	Ferguson's	65	Perez	Juan
462	Bargains Galore	65	Perez	Juan
608	Johnson's Department Store	65	Perez	Juan

Fields from the Customer table

Fields from the Rep table

Figures 10.50-10.51: Query to Restrict Records in Join

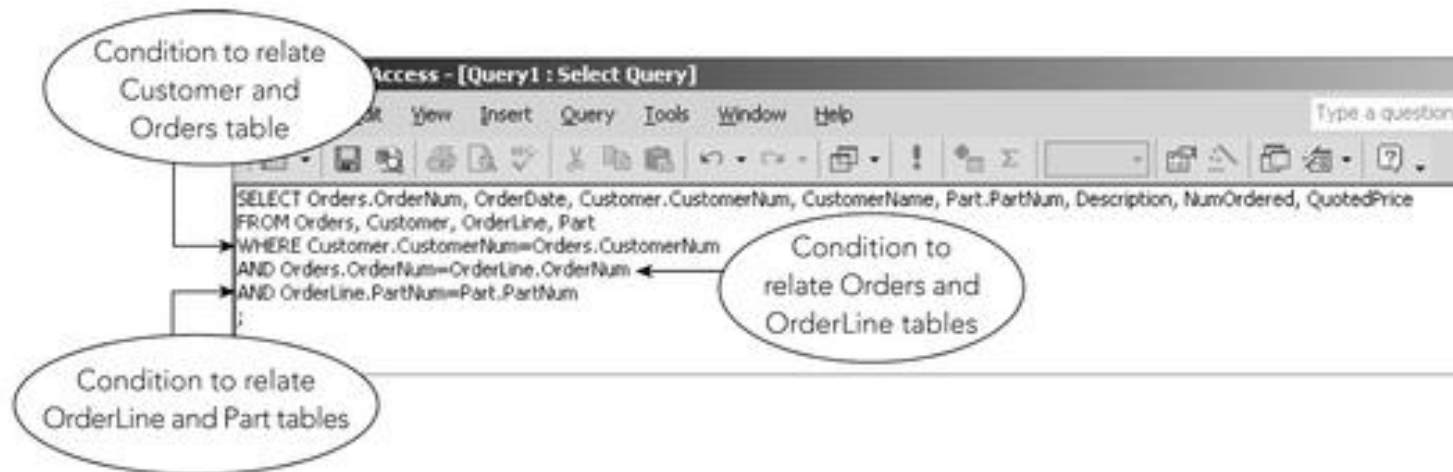


Microsoft Access - [Query1 : Select Query]

File Edit View Insert Format Records Tools Window Help

CustomerNum	CustomerName	RepNum	LastName	FirstName
282	Brookings Direct	35	Hull	Richard
462	Bargains Galore	65	Perez	Juan
608	Johnson's Department Store	65	Perez	Juan

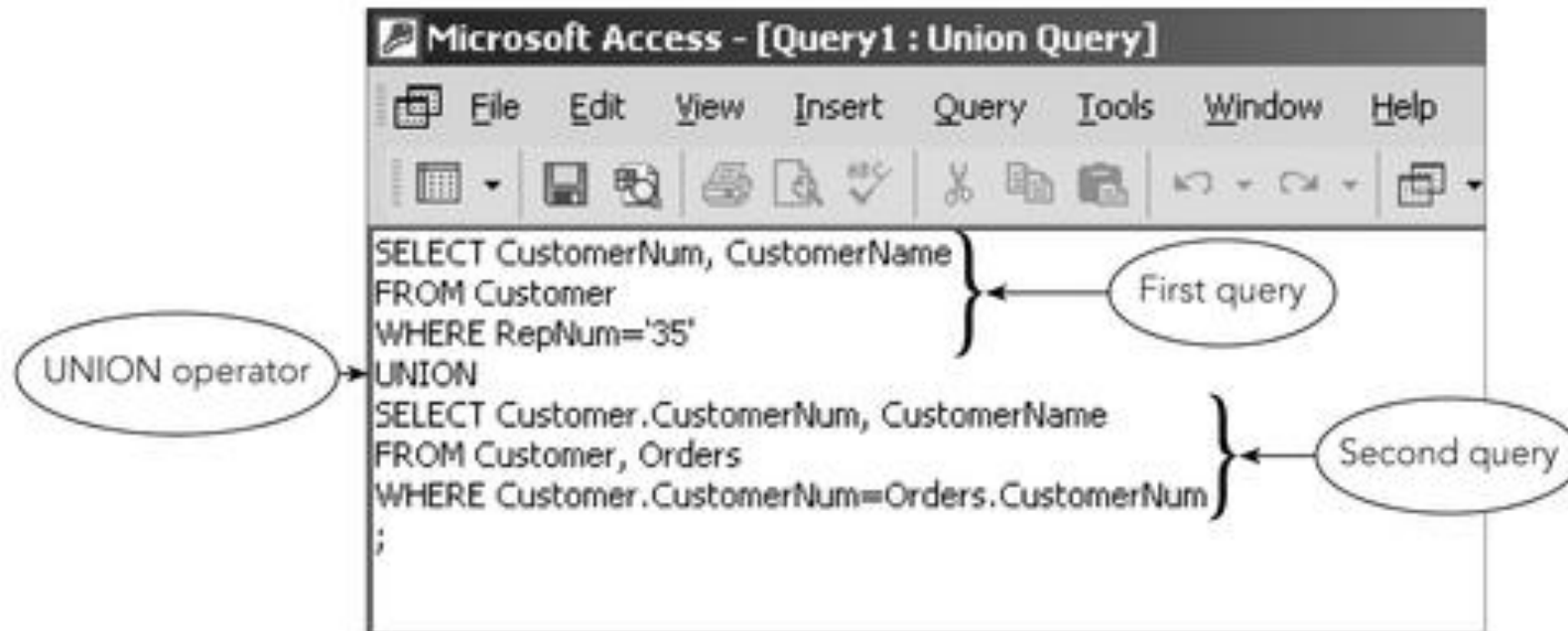
Figures 10.52-10.53: Query to Join Multiple Tables



Microsoft Access - [Query1 : Select Query]

OrderNum	OrderDate	CustomerNum	CustomerName	PartNum	Description	NumOrdered	QuotedPrice
21608	10/20/2003	148	AI's Appliance and Sport	AT94	Iron	11	\$21.95
21610	10/20/2003	356	Ferguson's	DR93	Gas Range	1	\$495.00
21610	10/20/2003	356	Ferguson's	DW11	Washer	1	\$399.99
21613	10/21/2003	408	The Everything Shop	KL62	Dryer	4	\$329.95
21614	10/21/2003	282	Brookings Direct	KT03	Dishwasher	2	\$595.00
21617	10/23/2003	608	Johnson's Department Store	BV06	Home Gym	2	\$794.95
21617	10/23/2003	608	Johnson's Department Store	CD52	Microwave Oven	4	\$150.00
21619	10/23/2003	148	AI's Appliance and Sport	DR93	Gas Range	1	\$495.00
21623	10/23/2003	608	Johnson's Department Store	KV29	Treadmill	2	\$1,290.00

Figures 10.54-10.55: SQL Query to Perform Union



The screenshot shows the Microsoft Access interface with the title bar "Microsoft Access - [Query1 : Union Query]". The menu bar includes File, Edit, View, Insert, Format, Records, Tools, Window, and Help. The toolbar contains various icons for data manipulation. The data view displays the following table:

CustomerNum	CustomerName
148	AI's Appliance and Sport
282	Brookings Direct
356	Ferguson's
408	The Everything Shop
608	Johnson's Department Store
687	Lee's Sport and Appliance
725	Deerfield's Four Seasons

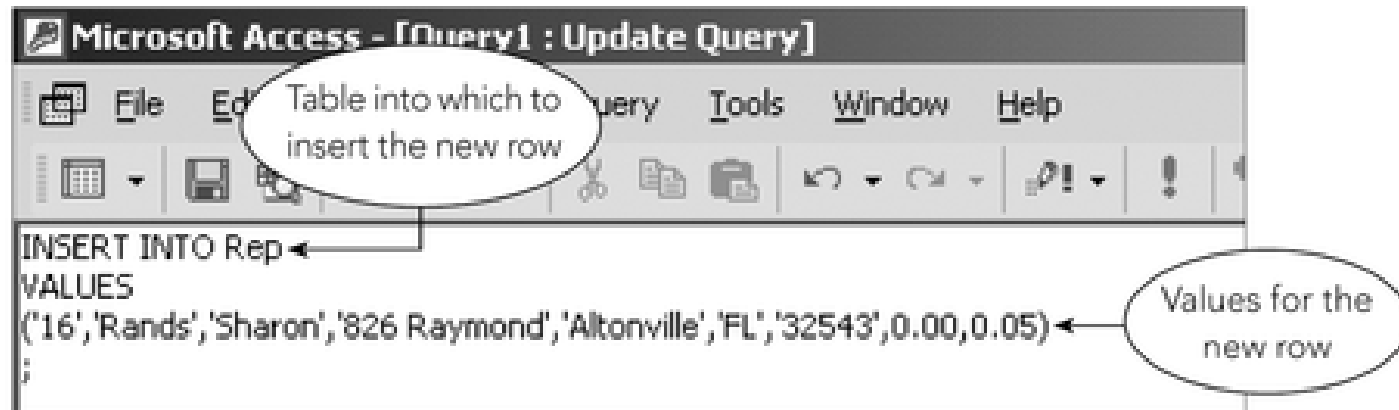
An annotation in the image includes:

- A bracket on the right side of the table is labeled "Customers of rep 35 or who have orders on file, or both".

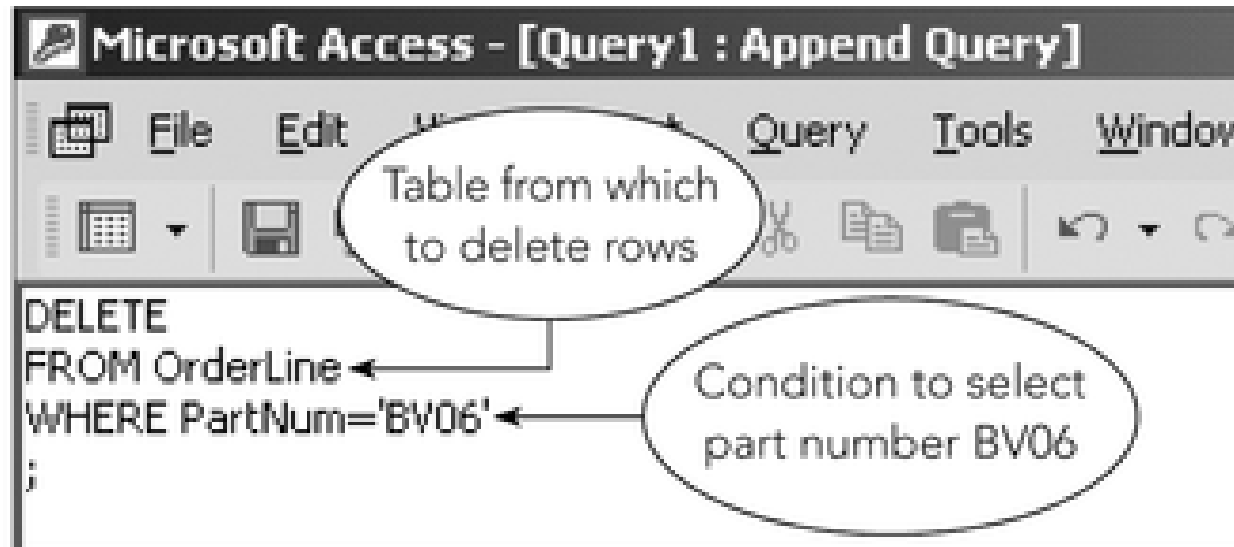
Updating Tables

- ◆ UPDATE command used to make changes to existing data
- ◆ INSERT command used to add new data to a table
- ◆ DELETE command used to delete data from the database

Figures 10.56-10.57: SQL Query to Update Data



Figures 10.58: SQL Query to Delete Rows



Create a Table from a Query

- ◆ INTO clause used to save the results of a query as a table
- ◆ Specified before FROM and WHERE clauses

Figures 10.59-10.60: SQL Query to Create New Table

Microsoft Access - [Query1 : Select Query]

File Edit View Insert Query Tools

SELECT *
INTO SmallCust
FROM Customer
WHERE CreditLimit <= 7500
;

Annotations:
- INTO clause
- Name of table to create

Microsoft Access - [SmallCust : Table]

Edt View Insert Format Records Tools Window Help

Type a question for help

Records inserted from the query results

CustomerNum	CustomerName	Street	City	State	Zip	Balance	CreditLimit	RepNum
148	Al's Appliance and Sport	2837 Greenway	Fillmore	FL	33336	\$6,550.00	\$7,500.00	20
356	Ferguson's	382 Wildwood	Northfield	FL	33146	\$5,785.00	\$7,500.00	65
408	The Everything Shop	1828 Raven	Crystal	FL	33503	\$5,285.25	\$5,000.00	35
687	Lee's Sport and Appliance	282 Evergreen	Altontville	FL	32543	\$2,851.00	\$5,000.00	35
725	Deerfield's Four Seasons	282 Columbia	Sheldon	FL	33553	\$248.00	\$7,500.00	35
842	All Season	28 Lakenview	Grove	FL	33321	\$8,221.00	\$7,500.00	20

Summary

- ◆ SQL (Structured Query Language): language for manipulating relational databases
- ◆ Three classes of statements: definition, query, and manipulation
- ◆ You create objects with the CREATE statement
- ◆ You perform queries with the SELECT statement → the condition is part of the WHERE clause

Summary (con't.)

- ◆ Simple queries use operators such as $<$, $>$, etc. to compare field names with the values you are seeking
- ◆ Compound conditions are formed with logical operators, AND, OR, and NOT
- ◆ Queries can be nested by using subqueries
- ◆ The GROUP BY clause can group data in a query
- ◆ The JOIN clause can combine data from two or more tables

Summary

- ◆ Built-in functions allow you to count rows in a query and summarize data, such as sums or averages
- ◆ The UNION statement allows you to view data from two queries in one result set
- ◆ SQL allows you to create tables from queries with the INTO clause
- ◆ You can delete and update data as well