



Principles of Database Systems

Course Number: CSGY-6083
Section Number: B

Module 3

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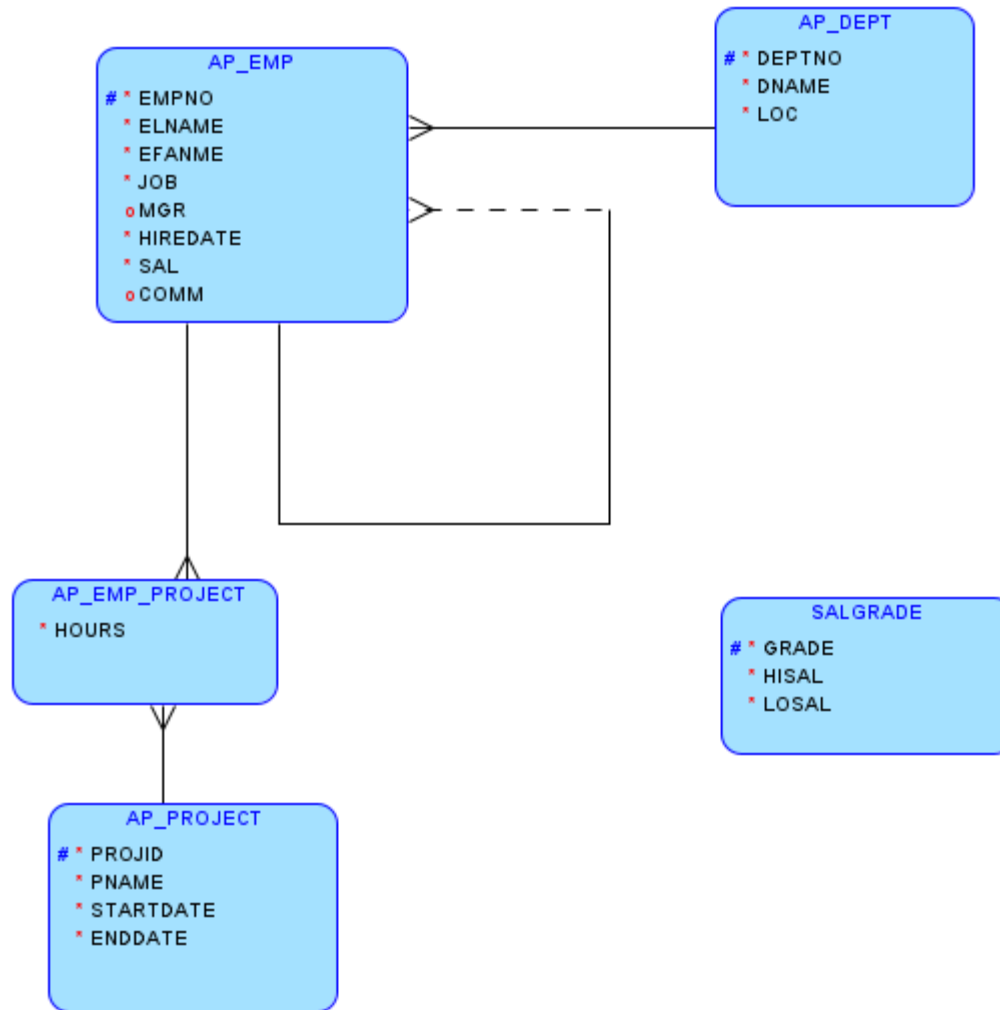
Introduction to SQL and Advanced SQL

Exercise Schema and Practice Tutorials

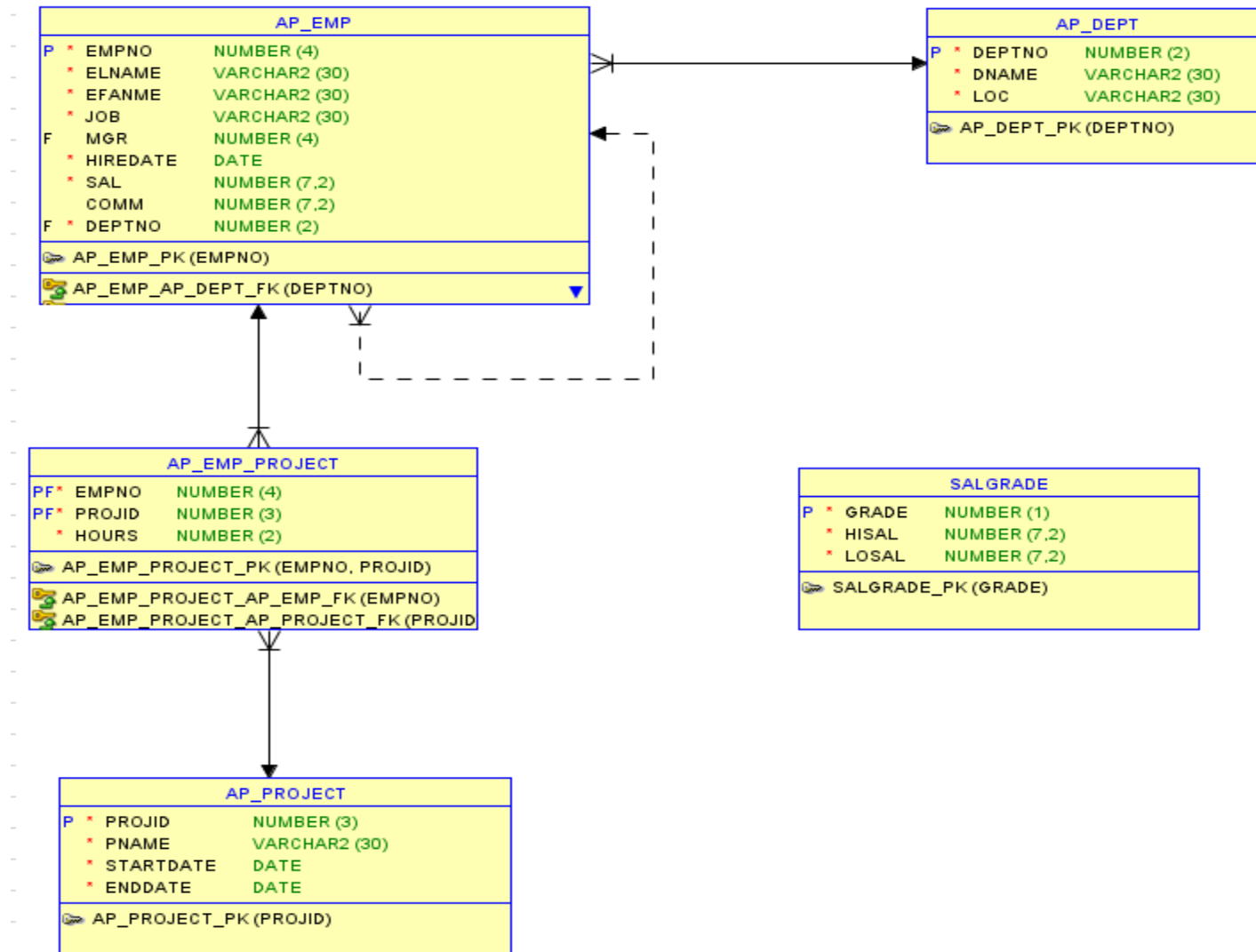
Objectives

- **SQL (Structure Query Language) overview**
- **Define a database using SQL Data Definition Language (DDL)**
- **Establish referential integrity using SQL**
- **Establish domain constraints using SQL**
- **Write single table queries using SQL**
- **Use built-in functions in SQL queries**

Logical Model ERD



Relational model



Integrity Constraints

- **Domain Constraints**
 - Allowable values for an attribute
- **Entity Integrity**
 - All primary key fields **MUST** contain data values.
- **Referential Integrity**
 - Rules that maintain consistency between the rows of two related tables.

Table Name **EMP** **EMPLOYEE TABLE**

Column Name	Datatype	Size	Optional/Mandatory	Comment
EMPNO	NUMERIC	4	Mandatory	Employee ID Number
ENAME	VARCHAR	30	Mandatory	Employee Frist Name
JOB	VARCHAR	30	Mandatory	Employee Functional Role
MGR	NUMERIC	4	Optional	Employee Manager ID
HIREDATE	DATE		Mandatory	Employee Join Date
SAL	NUMERIC	(7,2)	Mandatory	Employee Monthly Salary in USD
COMM	NUMERIC	(7,2)	Optional	Employee commission

Table Name **DEPT** **DEPARTMENT TABLE**

Column Name	Datatype	Size	Optional/Mandatory	Comment
DEPTNO	NUMERIC	2	Mandatory	Department ID Number
DNAME	VARCHAR	30	Mandatory	Department Name
LOC	VARCHAR	30	Mandatory	Location City of the Department

Table Name **PROJECT** **ORGANIZATION PROJECTS**

Column Name	Datatype	Size	Optional/Mandatory	Comment
PROJID	NUMERIC	3	Mandatory	Project ID Number
PNAME	VARCHAR	30	Mandatory	Name of the Project
STARTDATE	DATE		Mandatory	Start Date of the Project
ENDDATE	DATE		Mandatory	End Date of the Project

Integrity constraints

EMP								DEPT		
EMPNO	ENAME	JOB	MGR	HIREDATE	SAL	COMM	DEPTNO	DEPTNO	DNAME	LOC
7369	SMITH	CLERK	7902	10/8/2001	2400		20	10	ACCOUNTING	NEW YORK
7499	ALLEN	SALESMAN	7698	12/12/2001	4800	600	30	20	RESEARCH	DALLAS
7521	WARD	SALESMAN	7698	12/14/2001	3750	1000	30	30	SALES	CHICAGO
7566	JONES	MANAGER	7839	1/22/2002	8925		20	40	OPERATIONS	BOSTON
7654	MARTIN	SALESMAN	7698	7/20/2002	3750	2800	30			
7698	BLAKE	MANAGER	7839	2/20/2002	8550		30			
7782	CLARK	MANAGER	7839	3/31/2002	7350		10			
7788	SCOTT	ANALYST	7566	2/8/2008	9000		20			
7839	KING	PRESIDENT		9/8/2002	15000		10			
7844	TURNER	SALESMAN	7698	6/30/2002	4500	0	30			
7876	ADAMS	CLERK	7788	3/13/2008	3300		20			
7900	JAMES	CLERK	7698	9/24/2002	2850		30			
7902	FORD	ANALYST	7566	9/24/2002	9000		20			
7934	MILLER	CLERK	7782	11/14/2002	3900		10			

Integrity Constraints

- **Referential Integrity–rule** states that any foreign key value of Child Table (Many side of relationship) **MUST** match a primary key value of Parent Table (One side of relationship)
-- the foreign key can be null (if one to many relationship of target side is optional)
 - **Delete Rules**
 - **Restrict**—don't allow delete of “parent” side if related rows exist in “dependent (child)” side
 - **Cascade**—automatically delete “dependent(child)” side rows that correspond with the “parent” side row to be deleted
 - **Set-to-Null**—set the foreign key in the dependent side to null (This will require FK column optional (allowable null values), and hence optional relationship between Parent and Child table)

SQL Overview

- **Structured Query Language – often pronounced “Sequel”**
- **The standard for relational database management systems (RDBMS)**
- **RDBMS: A database management system that manages data as a collection of tables in which all relationships are represented by common attributes in related tables (PK and FK)**

Benefits of a Standardized Relational Language

- **Reduced training costs**
- **Productivity**
- **Application portability**
- **Reduced dependence on a single vendor**
- **Cross-system communication**

SQL OPERATORS

THE ARITHMETIC OPERATORS

OPERATOR	DESCRIPTION
+	Add
-	Subtract
*	Multiply
/	Divide
^	Raise to the power of (some applications use ** instead of ^)

COMPARISON OPERATORS

SYMBOL	MEANING
=	Equal to
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
<> or !=	Not equal to

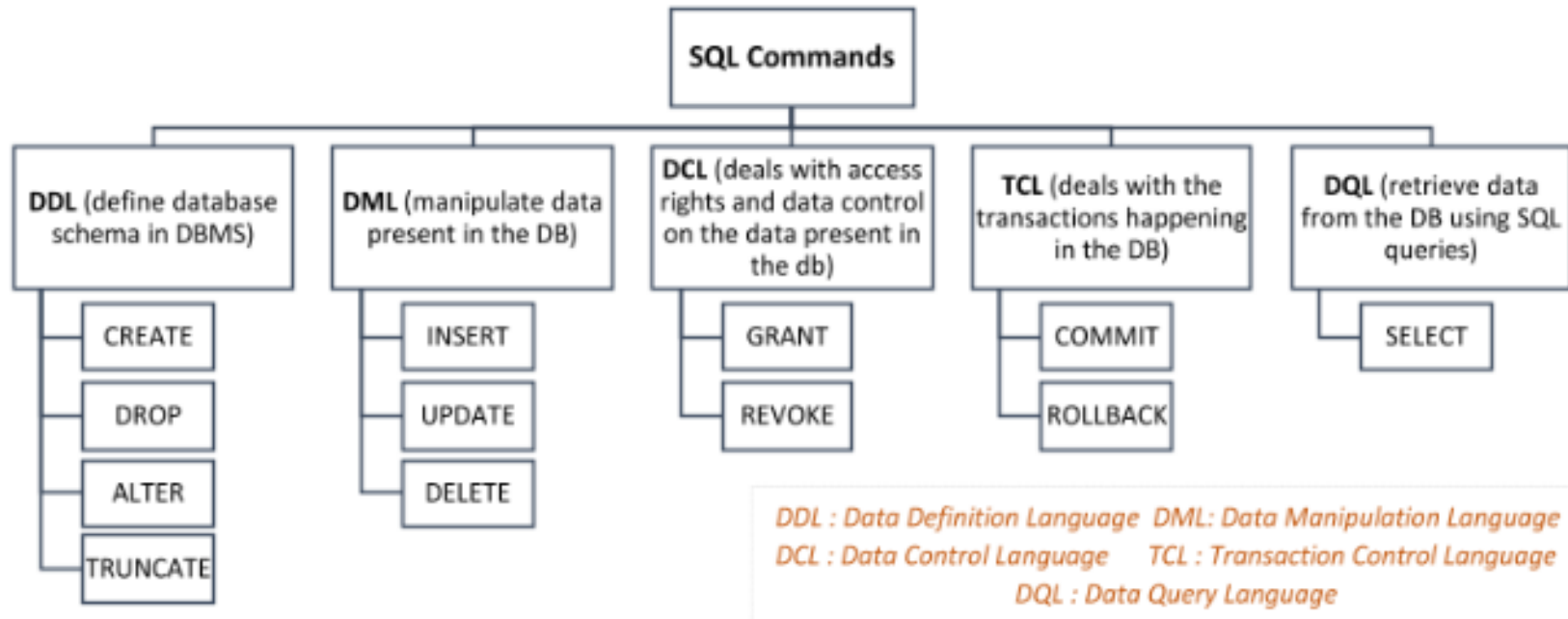
LOGICAL OPERATORS

AND: True if both conditions are true

OR: False only if both conditions are false

NOT: Invert the logical condition

Structured Query language (SQL)



DDL: Data Definition Language

DCL: Data Control Language

DQL: Data Query Language

DML: Data Manipulation Language

TCL: Transaction Control Language

SELECT

Horizontal Filter

Original table

P_CODE	P_DESCRIPTION	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

SELECT ALL yields

New table

P_CODE	P_DESCRIPTION	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

SELECT only PRICE less than \$2.00 yields

P_CODE	P_DESCRIPTION	PRICE
213345	9v battery	1.92
254467	100W bulb	1.47

SELECT only P_CODE = 311452 yields

P_CODE	P_DESCRIPTION	PRICE
311452	Powerdrill	34.99

Original table

P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

PROJECT PRICE yields

New table

PRICE
5.26
25.15
10.99
1.92
1.47
34.99

PROJECT P_DESCRIPT and PRICE yields

P_DESCRIPT	PRICE
Flashlight	5.26
Lamp	25.15
Box Fan	10.99
9v battery	1.92
100W bulb	1.47
Powerdrill	34.99

PROJECT P_CODE and PRICE yields

P_CODE	PRICE
123456	5.26
123457	25.15
123458	10.99
213345	1.92
254467	1.47
311452	34.99

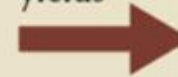
UNION

P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

UNION

P_CODE	P_DESCRIPT	PRICE
345678	Microwave	160.00
345679	Dishwasher	500.00
123458	Box Fan	10.99

yields



P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99
345678	Microwave	160
345679	Dishwasher	500

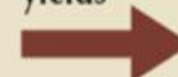
UNION ALL

P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

UNION
ALL

P_CODE	P_DESCRIPT	PRICE
345678	Microwave	160.00
345679	Dishwasher	500.00
123458	Box Fan	10.99

yields



P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99
345678	Microwave	160
345679	Dishwasher	500
345678	Microwave	160.00
345679	Dishwasher	500.00
123458	Box Fan	10.99

INTERSECT

STU_FNAME	STU_LNAME
George	Jones
Jane	Smith
Peter	Robinson
Franklin	Johnson
Martin	Lopez

INTERSECT

EMP_FNAME	EMP_LNAME
Franklin	Lopez
William	Turner
Franklin	Johnson
Susan	Rogers

yields



STU_FNAME	STU_LNAME
Franklin	Johnson

DIFFERENCE

STU_FNAME	STU_LNAME
George	Jones
Jane	Smith
Peter	Robinson
Franklin	Johnson
Martin	Lopez

DIFFERENCE

EMP_FNAME	EMP_LNAME
Franklin	Lopez
William	Turner
Franklin	Johnson
Susan	Rogers

yields



STU_FNAME	STU_LNAME
George	Jones
Jane	Smith
Peter	Robinson
Martin	Lopez

PRODUCT

CARTESIAN JOIN (CROSS JOIN)

P_CODE	P_DESCRIPT	PRICE
123456	Flashlight	5.26
123457	Lamp	25.15
123458	Box Fan	10.99
213345	9v battery	1.92
254467	100W bulb	1.47
311452	Powerdrill	34.99

PRODUCT

STORE	AISLE	SHELF
23	W	5
24	K	9
25	Z	6

yields



P_CODE	P_DESCRIPT	PRICE	STORE	AISLE	SHELF
123456	Flashlight	5.26	23	W	5
123456	Flashlight	5.26	24	K	9
123456	Flashlight	5.26	25	Z	6
123457	Lamp	25.15	23	W	5
123457	Lamp	25.15	24	K	9
123457	Lamp	25.15	25	Z	6
123458	Box Fan	10.99	23	W	5
123458	Box Fan	10.99	24	K	9
123458	Box Fan	10.99	25	Z	6
213345	9v battery	1.92	23	W	5
213345	9v battery	1.92	24	K	9
213345	9v battery	1.92	25	Z	6
311452	Powerdrill	34.99	23	W	5
311452	Powerdrill	34.99	24	K	9
311452	Powerdrill	34.99	25	Z	6
254467	100W bulb	1.47	23	W	5
254467	100W bulb	1.47	24	K	9
254467	100W bulb	1.47	25	Z	6

TWO TABLES THAT WILL BE USED IN JOIN ILLUSTRATIONS

Table name: CUSTOMER

CUS_CODE	CUS_LNAME	CUS_ZIP	AGENT_CODE
1132445	Walker	32145	231
1217782	Adares	32145	125
1312243	Rakowski	34129	167
1321242	Rodriguez	37134	125
1542311	Smithson	37134	421
1657399	Varloo	32145	231

Table name: AGENT

AGENT_CODE	AGENT_PHONE
125	6152439887
167	6153426778
231	6152431124
333	9041234445

PRODUCT

CARTESIAN JOIN (CROSS JOIN)

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1132445	Walker	32145	231	125	6152439887
1132445	Walker	32145	231	167	6153426778
1132445	Walker	32145	231	231	6152431124
1132445	Walker	32145	231	333	9041234445
1217782	Adares	32145	125	125	6152439887
1217782	Adares	32145	125	167	6153426778
1217782	Adares	32145	125	231	6152431124
1217782	Adares	32145	125	333	9041234445
1312243	Rakowski	34129	167	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1312243	Rakowski	34129	167	231	6152431124
1312243	Rakowski	34129	167	333	9041234445
1321242	Rodriguez	37134	125	125	6152439887
1321242	Rodriguez	37134	125	167	6153426778
1321242	Rodriguez	37134	125	231	6152431124
1321242	Rodriguez	37134	125	333	9041234445
1542311	Smithson	37134	421	125	6152439887
1542311	Smithson	37134	421	167	6153426778
1542311	Smithson	37134	421	231	6152431124
1542311	Smithson	37134	421	333	9041234445
1657399	Vanloo	32145	231	125	6152439887
1657399	Vanloo	32145	231	167	6153426778
1657399	Vanloo	32145	231	231	6152431124
1657399	Vanloo	32145	231	333	9041234445

NATURAL JOIN, INNER JOIN, SIMPLE JOIN

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	125	6152439887
1321242	Rodriguez	37134	125	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1132445	Walker	32145	231	231	6152431124
1657399	Vanloo	32145	231	231	6152431124

LEFT OUTER JOIN

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	125	6152439887
1321242	Rodriguez	37134	125	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1132445	Walker	32145	231	231	6152431124
1657399	Vanloo	32145	231	231	6152431124
1542311	Smithson	37134	421		

RIGHT OUTER JOIN

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	125	6152439887
1321242	Rodriguez	37134	125	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1132445	Walker	32145	231	231	6152431124
1657399	Vanloo	32145	231	231	6152431124
				333	9041234445

FULL OUTER JOIN

CUS_CODE	CUS_LNAME	CUS_ZIP	CUSTOMER.AGENT_CODE	AGENT.AGENT_CODE	AGENT_PHONE
1217782	Adares	32145	125	125	6152439887
1321242	Rodriguez	37134	125	125	6152439887
1312243	Rakowski	34129	167	167	6153426778
1132445	Walker	32145	231	231	6152431124
1657399	Vanloo	32145	231	231	6152431124
				333	9041234445
1542311	Smithson	37134	421		

Exercise Schema and SQL Tutorials

Create Exercise Schema and practice SQLs from Tutorials posted on **Module 3: SQL Tutorial** folder.

Follow readme document to setup exercise schema and practice SQLs from tutorials posted.

Oracle Online Database

ORACLE LIVE SQL: <https://livesql.oracle.com/>

Online Tool to convert SQL code from one RDBMS to another, e.g., Oracle to MySQL

<https://www.sqlines.com/online>



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