

# WORKING WITH RELATIONAL DATABASES EXERCISE MANUAL



Fidelity LEAP  
Technology Immersion Program

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## Table of Contents

<b>Chapter 1: What Is Structured Query Language?</b>	<b>1</b>
Exercise 1.1: Using SQL Developer	1
<b>Chapter 2: SQL Query Syntax</b>	<b>3</b>
Exercise 2.1: Selecting Data	3
<b>Chapter 3: SQL Scalar Functions</b>	<b>9</b>
Exercise 3.1: Using Scalar Functions	9
<b>Chapter 4: SQL Joins</b>	<b>13</b>
Exercise 4.1: Working with <code>INNER JOINS</code>	13
Exercise 4.2: Using <code>OUTER JOINS</code>	17
<b>Chapter 5: Additional SQL Functions</b>	<b>23</b>
Exercise 5.1: Additional SQL Functions	23
<b>Chapter 6: Data Manipulation Language</b>	<b>25</b>
Exercise 6.1: Manipulating Data	25
<b>Chapter 7: Databases with JDBC (Java Database Connectivity)</b>	<b>27</b>
Exercise 7.1: Connecting to a Database	27
Exercise 7.2: Creating Objects from a Database Query	29
<b>Chapter 8: Updating Databases</b>	<b>33</b>
Exercise 8.1: Inserting a Record with JDBC	33
Exercise 8.2: Updating and Deleting Records	35
Exercise 8.3: Working with Multi-Table Queries	36
<b>Chapter 9: Working with a Data Access Object</b>	<b>37</b>
Exercise 9.1: Debugging Data Access Object Methods	37
Optional Exercise 9.2: Testing a Business Service with a Mock DAO	38
Exercise 9.3 Putting It All Together	40
<b>Chapter 10: Advanced JDBC</b>	<b>41</b>
Optional Exercise 10.1: JDBC Code Review	41
Optional Exercise 10.2: One-to-Many Queries	42
Optional Exercise 10.3: Testing a Service Proxy with Mockito	43
Optional Exercise 10.4: Writing an Integration Test for the Service and DAO	46
<b>Chapter 11: Aggregating Information</b>	<b>49</b>
Exercise 11.1: Using the Aggregate Functions	49
Exercise 11.2: <code>GROUP BY</code> and <code>HAVING</code>	51
Exercise 11.3: Using Subqueries	54
<b>Chapter 12: Set Operators</b>	<b>57</b>
Exercise 12.1: Set Operators	57

<b>Chapter 13: Programming with PL/SQL .....</b>	<b>59</b>
Exercise 13.1: Building Anonymous Blocks .....	59
Exercise 13.2: Using Cursors .....	61
<b>Chapter 14: Creating Stored Procedures, Functions, and Packages .....</b>	<b>63</b>
Exercise 14.1: Stored Procedures, Functions, and Packages .....	63
<b>Chapter 15: Testing PL/SQL .....</b>	<b>67</b>
Exercise 15.1: Writing PL/SQL Tests with utPLSQL .....	67
Exercise 15.2: Testing Updates With utPLSQL .....	69
<b>Chapter 16: Creating Triggers.....</b>	<b>71</b>
Exercise 16.1: Working with Triggers .....	71
<b>Chapter 17: Data Definition Language .....</b>	<b>73</b>
Exercise 17.1: Table Management .....	73
<b>Chapter 20: Amazon DynamoDB .....</b>	<b>77</b>
Exercise 20.1: Access DynamoDB Using AWS CLI .....	77
Exercise 20.2: Java Document API .....	80
Exercise 20.3: Java Object Mapper .....	81

## Chapter 1: What Is Structured Query Language?

### Exercise 1.1: Using SQL Developer

For this exercise, we will become familiar with SQL Developer.

1. Locate the SQL Developer executable on the desktop.
2. Double-click to see that it starts correctly.
3. Right-click the `HR` connection and select Properties from the menu. Examine the parameters. Where is the Oracle database server running?
4. Make the following configuration changes in the Tools | Preferences Menu:
  - a. In the Code Editor Line Gutter section, choose the option to **Show Line Numbers**.

*Tools / Preferences / Code Editor / Line Gutter*

- b. In the Database NLS Parameters section, modify the Date Format to display **DD-MON-YYYY**.

*Tools / Preferences / Database / NLS Parameters*

5. Open the `HR` connection.

*You can do this either by clicking the + (plus sign) to the left of the Connection Name or by right-clicking the Connection icon and selecting Connect.*

6. Expand the **Tables** branch to show all of the tables from `HR`.

*Click the + (plus sign) or double-click the name.*

7. How many tables are owned by `HR`?

- 
8. Open SQL Worksheet for `HR`.

*Use the SQL Worksheet icon in the toolbar.*

9. Enter the following statement into the SQL Worksheet window and execute it:

```
SELECT * FROM locations;
```

*Click the Run Statement icon or the <F9> key to run the statement.*

10. Execute the same statement as a script and note the difference.

*Click the Run Script icon or the <F5> key to run the script.*

11. Save the SQL script for later use as a file called `loc.sql`.

12. Enter the following statement underneath the existing statement.

```
SELECT * FROM countries;
```

13. Execute both statements by clicking the <F9> key and note the result.

14. Now, execute both statements together as a script (<F5>). Note that the results of both statements are displayed in the Script Output.

15. Clear the contents of the SQL Worksheet.

16. Open the `loc.sql` file.

*Click the Open File icon or use the File menu and select Open.*

17. Run the SQL statement.



Congratulations!  
You have finished  
this lab exercise!

## Chapter 2: SQL Query Syntax

### Exercise 2.1: Selecting Data

Connect to the SCOTT account

*Unless the order is specified, the order of your results may differ.*

1. Write a query to display the dname and deptno of all rows in the dept table.

DNAME	DEPTNO
ACCOUNTING	10
RESEARCH	20
SALES	30
OPERATIONS	40

2. Write a query to display ALL of the columns and rows in the dept table.

DEPTNO	DNAME	LOC
10	ACCOUNTING	NEW YORK
20	RESEARCH	DALLAS
30	SALES	CHICAGO
40	OPERATIONS	BOSTON

3. Write a query to display the dname, deptno, and location of all rows in the dept table labeling them Name, DEPT# and Dept Location, respectively.

Name	DEPT#	Dept Location
ACCOUNTING	10	NEW YORK
RESEARCH	20	DALLAS
SALES	30	CHICAGO
OPERATIONS	40	BOSTON

4. Write a query to display the deptno of each row in the emp table.

DEPTNO
20
30
30
20
30
30
10
20
10
30
20
30
20
10

## Exercise Manual

5. Write a query to display each deptno in the emp table only once.

```
DEPTNO
-----
      30
      10
      20
```

6. Write a query to display the deptno and job of each row in the emp table.

```
DEPTNO  JOB
-----  -
      20  CLERK
      30  SALESMAN
      30  SALESMAN
      20  MANAGER
      30  SALESMAN
      30  MANAGER
      10  MANAGER
      20  ANALYST
      10  PRESIDENT
      30  SALESMAN
      20  CLERK
      30  CLERK
      20  ANALYST
      10  CLERK
```

7. Write a query to display each unique combination of deptno and job in the emp table.

```
DEPTNO  JOB
-----  -
      20  MANAGER
      20  ANALYST
      10  PRESIDENT
      10  CLERK
      30  SALESMAN
      10  MANAGER
      20  CLERK
      30  MANAGER
      30  CLERK
```

8. Write a query to display the names of the employees who work for dept 30 in the emp table.

```
ENAME
-----
ALLEN
WARD
MARTIN
BLAKE
TURNER
JAMES
```



## Exercise Manual

---

9. Write a query to display the names of the employees who were hired on Dec. 17, 1981. Specify the date in a safe format.

```
no rows selected
```

10. Write a query to display the names of the employees who were hired on or after Dec. 17, 1981.

```
ENAME
-----
SCOTT
ADAMS
MILLER
```

11. Write a query to display the names of the employees who have the job of clerk.

```
no rows selected
```

12. Write a query to display the names of the employees who have the job of CLERK.

```
ENAME
-----
SMITH
ADAMS
JAMES
MILLER
```

13. Write a query to display the names of the employees whose salary is greater than 2500.

```
ENAME
-----
JONES
BLAKE
SCOTT
KING
FORD
```

14. Write a query to display the names of the employees whose salary is in the range (inclusive) of 1000 and 1600.

```
NAME
-----
ALLEN
WARD
MARTIN
TURNER
ADAMS
MILLER
```

## Exercise Manual

15. Write a query to display the names of the employees whose names contain "ER".

```
ENAME
-----
TURNER
MILLER
```

16. Write a query to display the names and employee numbers of the employees whose commission is undefined.

```
EMPNO  ENAME
-----
7369 SMITH
7566 JONES
7698 BLAKE
7782 CLARK
7788 SCOTT
7839 KING
7876 ADAMS
7900 JAMES
7902 FORD
7934 MILLER
```

17. Write a query to display the names, employee numbers, and commissions of the employees, sequencing the data in commission ascending order.

	EMPNO	ENAME	COMM
1	7844	TURNER	0
2	7499	ALLEN	300
3	7521	WARD	500
4	7654	MARTIN	1400
5	7788	SCOTT	(null)
6	7839	KING	(null)
7	7876	ADAMS	(null)
8	7900	JAMES	(null)
9	7902	FORD	(null)
10	7934	MILLER	(null)
11	7698	BLAKE	(null)
12	7566	JONES	(null)
13	7369	SMITH	(null)
14	7782	CLARK	(null)

## Exercise Manual

18. Write a query to display the names, employee numbers, and commissions of the employees sequencing the data in commission descending order.

	E...	ENAME	COMM
1	7369	SMITH	(null)
2	7782	CLARK	(null)
3	7902	FORD	(null)
4	7900	JAMES	(null)
5	7876	ADAMS	(null)
6	7566	JONES	(null)
7	7698	BLAKE	(null)
8	7934	MILLER	(null)
9	7788	SCOTT	(null)
10	7839	KING	(null)
11	7654	MARTIN	1400
12	7521	WARD	500
13	7499	ALLEN	300
14	7844	TURNER	0

19. Write a query to display the names and employee numbers of the employees sequencing the data in commission descending order, forcing those with unknown commissions to the bottom of the list.

	EMPNO	ENAME	COMM
1	7654	MARTIN	1400
2	7521	WARD	500
3	7499	ALLEN	300
4	7844	TURNER	0
5	7788	SCOTT	(null)
6	7839	KING	(null)
7	7876	ADAMS	(null)
8	7900	JAMES	(null)
9	7902	FORD	(null)
10	7934	MILLER	(null)
11	7698	BLAKE	(null)
12	7566	JONES	(null)
13	7369	SMITH	(null)
14	7782	CLARK	(null)



Congratulations!  
You have finished  
this lab exercise!

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## Chapter 3: SQL Scalar Functions

### Exercise 3.1: Using Scalar Functions

*Unless the order is specified, the order of your results may differ.*

Connect to the HR account.

1. Write a query to display the first name, last name, and salary of all employees in department 30, formatting the salary with commas and a floating dollar sign.

FIRST_NAME	LAST_NAME	SALARY
Den	Raphaely	\$11,000
Alexander	Khoo	\$3,100
Shelli	Baida	\$2,900
Sigal	Tobias	\$2,800
Guy	Himuro	\$2,600
Karen	Colmenares	\$2,500

2. Write a query to display the first name, last name, and date hired of all employees in department 30, formatting the date to be year-month#-day.

FIRST_NAME	LAST_NAME	Date Hired
Den	Raphaely	2002-12-07
Alexander	Khoo	2003-05-18
Shelli	Baida	2005-12-24
Sigal	Tobias	2005-07-24
Guy	Himuro	2006-11-15
Karen	Colmenares	2007-08-10

3. Write a query to display the salary of all employees in department 30. Also show the salary rounded and truncated to thousands.

FIRST_NAME	LAST_NAME	RDSAL	TSAL	SALARY
Den	Raphaely	11000	11000	11000
Alexander	Khoo	3000	3000	3100
Shelli	Baida	3000	2000	2900
Sigal	Tobias	3000	2000	2800
Guy	Himuro	3000	2000	2600
Karen	Colmenares	3000	2000	2500

## Exercise Manual

- Write a query to display names of all employees in department 30. Their first name should be in lower case; their last name in upper case. Sequence the list in (ascending) first name, last name order.

LNAME	UNAME
alexander	KHOO
den	RAPHAELY
guy	HIMURO
karen	COLMENARES
shelll	BAIDA
sigal	TOBIAS

- Write a query to display the initial of the first name followed by a period followed by the last name of all employees in department 30. Sequence the list in alphabetical order of this formatted name.

NAME
A. Khoo
D. Raphaely
G. Himuro
K. Colmenares
S. Baida
S. Tobias

- Write a query to display the street address, followed by the street address stripped of any leading numeric digits, spaces, or dashes (Street Name) for all rows in the locations table. Order the list by the Street Name.

STREET_ADDRESS	Street Name
8204 Arthur St	Arthur St
6092 Boxwood St	Boxwood St
93091 Calle della Testa	Calle della Testa
2004 Charade Rd	Charade Rd
9702 Chester Road	Chester Road
198 Clementi North	Clementi North
2011 Interiors Blvd	Interiors Blvd
2014 Jabberwocky Rd	Jabberwocky Rd
9450 Kamiya-cho	Kamiya-cho
40-5-12 Laogianggen	Laogianggen
Magdalen Centre, The Oxford Science Park	Magdalen Centre, The Oxford Science Park
Mariano Escobedo 9991	Mariano Escobedo 9991
Murtenstrasse 921	Murtenstrasse 921
Pieter Breughelstraat 837	Pieter Breughelstraat 837
Rua Frei Caneca 1360	Rua Frei Caneca 1360
20 Rue des Corps-Saints	Rue des Corps-Saints
Schwanthalerstr. 7031	Schwanthalerstr. 7031
2017 Shinjuku-ku	Shinjuku-ku
147 Spadina Ave	Spadina Ave
1297 Via Cola di Rie	Via Cola di Rie
12-98 Victoria Street	Victoria Street
1298 Vileparle (E)	Vileparle (E)
2007 Zagora St	Zagora St

## Exercise Manual

7. Write a query to display the street address, followed by length of the street address (Street Length) for all rows in the `locations` table. Sequence the list in the Street Length order.

STREET_ADDRESS	Street Length
8204 Arthur St	14
2007 Zagora St	14
2004 Charade Rd	15
9450 Kamiya-cho	15
6092 Boxwood St	15
147 Spadina Ave	15
2017 Shinjuku-ku	16
Murtenstrasse 921	17
9702 Chester Road	17
1298 Vileparle (E)	18
198 Clementi North	18
2014 Jabberwocky Rd	19
40-5-12 Laogianggen	19
2011 Interiors Blvd	19
1297 Via Cola di Rie	20
Schwanthalerstr. 7031	21
12-98 Victoria Street	21
Rua Frei Caneca 1360	21
Mariano Escobedo 9991	21
20 Rue des Corps-Saints	23
93091 Calle della Testa	23
Pieter Breughelstraat 837	25
Magdalen Centre, The Oxford Science Park	40

8. Write a query to display the location ID, the street address, city, and state province of all rows in the `locations` table that contain either the string "RUA" or "RUE" in the street address. Sequence the list in descending sequence on location ID.

LOCATION_ID	STREET_ADDRESS	CITY	STATE_PROVINCE
2900	20 Rue des Corps-Saints	Geneva	Geneve
2800	Rua Frei Caneca 1360	Sao Paulo	Sao Paulo



**Congratulations!**  
You have finished  
this lab exercise!

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## Chapter 4: SQL Joins

### Exercise 4.1: Working with INNER JOINS

#### Save your queries for later use.

Connect to the HR account.

1. Joining the `locations` and `departments` tables, display the city, location ID, and department name.

CITY	LOCATION_ID	DEPARTMENT_NAME
Southlake	1400	IT
South San Francisco	1500	Shipping
Seattle	1700	Administration
Seattle	1700	Purchasing
Seattle	1700	Executive
Seattle	1700	Finance
Seattle	1700	Accounting
Seattle	1700	Treasury
Seattle	1700	Corporate Tax
Seattle	1700	Control And Credit
Seattle	1700	Shareholder Services
Seattle	1700	Benefits
Seattle	1700	Manufacturing
Seattle	1700	Construction
Seattle	1700	Contracting
Seattle	1700	Operations
Seattle	1700	IT Support
Seattle	1700	NOC
Seattle	1700	IT Helpdesk
Seattle	1700	Government Sales
Seattle	1700	Retail Sales
Seattle	1700	Recruiting
Seattle	1700	Payroll
Toronto	1800	Marketing
London	2400	Human Resources
Oxford	2500	Sales
Munich	2700	Public Relations

## Exercise Manual

2. Joining the `locations` and `countries` tables, display the country name and city.

COUNTRY_NAME	CITY
Australia	Sydney
Brazil	Sao Paulo
Canada	Toronto
Canada	Whitehorse
Switzerland	Geneva
Switzerland	Bern
China	Beijing
Germany	Munich
India	Bombay
Italy	Roma
Italy	Venice
Japan	Tokyo
Japan	Hiroshima
Mexico	Mexico City
Netherlands	Utrecht
Singapore	Singapore
United Kingdom	London
United Kingdom	Oxford
United Kingdom	Stretford
United States of America	Southlake
United States of America	South San Francisco
United States of America	South Brunswick
United States of America	Seattle

## Exercise Manual

3. Joining the `locations`, `countries`, and `departments` tables, display the country name, city, and department name.

COUNTRY_NAME	CITY	DEPARTMENT_NAME
United States of America	Southlake	IT
United States of America	South San Francisco	Shipping
United States of America	Seattle	Administration
United States of America	Seattle	Purchasing
United States of America	Seattle	Executive
United States of America	Seattle	Finance
United States of America	Seattle	Accounting
United States of America	Seattle	Treasury
United States of America	Seattle	Corporate Tax
United States of America	Seattle	Control And Credit
United States of America	Seattle	Shareholder Services
United States of America	Seattle	Benefits
United States of America	Seattle	Manufacturing
United States of America	Seattle	Construction
United States of America	Seattle	Contracting
United States of America	Seattle	Operations
United States of America	Seattle	IT Support
United States of America	Seattle	NOC
United States of America	Seattle	IT Helpdesk
United States of America	Seattle	Government Sales
United States of America	Seattle	Retail Sales
United States of America	Seattle	Recruiting
United States of America	Seattle	Payroll
Canada	Toronto	Marketing
United Kingdom	London	Human Resources
United Kingdom	Oxford	Sales
Germany	Munich	Public Relations

4. Joining the `employees` and `job_history` tables, display the employee ID, first and last name, and the job ID. Display the output in sequence by `employee_id`.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	JOB_ID
101	Neena	Kochhar	AC_MGR
101	Neena	Kochhar	AC_ACCOUNT
102	Lex	De Haan	IT_PROG
114	Den	Raphaely	ST_CLERK
122	Payam	Kaufling	ST_CLERK
176	Jonathon	Taylor	SA_REP
176	Jonathon	Taylor	SA_MAN
200	Jennifer	Whalen	AD_ASST
200	Jennifer	Whalen	AC_ACCOUNT
201	Michael	Hartstein	MK_REP

## Exercise Manual

- Joining the `jobs` and `job_history` tables, display the job title, employee ID, and starting date for all employees who started in that job after Jan. 1, 1998.

JOB_TITLE	EMPLOYEE_ID	START_DATE
Public Accountant	200	01-JUL-2002
Accounting Manager	101	28-OCT-2001
Programmer	102	13-JAN-2001
Marketing Representative	201	17-FEB-2004
Sales Manager	176	01-JAN-2007
Sales Representative	176	24-MAR-2006
Stock Clerk	114	24-MAR-2006
Stock Clerk	122	01-JAN-2007

- Modify the above query: remove the start date restriction and also include the employees' first and last names.

JOB_TITLE	EMPLOYEE_ID	START_DATE	FIRST_NAME	LAST_NAME
Accounting Manager	101	28-OCT-2001	Neena	Kochhar
Public Accountant	101	21-SEP-1997	Neena	Kochhar
Programmer	102	13-JAN-2001	Lex	De Haan
Stock Clerk	114	24-MAR-2006	Den	Raphaely
Stock Clerk	122	01-JAN-2007	Payam	Kaufling
Sales Representative	176	24-MAR-2006	Jonathon	Taylor
Sales Manager	176	01-JAN-2007	Jonathon	Taylor
Administration Assistant	200	17-SEP-1995	Jennifer	Whalen
Public Accountant	200	01-JUL-2002	Jennifer	Whalen
Marketing Representative	201	17-FEB-2004	Michael	Hartstein



Congratulations!  
You have finished  
this lab exercise!

## Exercise 4.2: Using OUTER JOINS

Connect to the HR account.

Using the standard outer join syntax, write queries to display the following information:

## Exercise Manual

1. Joining the `employees` and `job_history` tables, display the employee ID, first and last name, and the job ID. Include all employees, whether or not they have any job history. Display in employee ID order. Modify your solution to Step 4 of the previous exercise.

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	JOB_ID
1	100	Steven	King	(null)
2	101	Neena	Kochhar	AC_ACCOUNT
3	101	Neena	Kochhar	AC_MGR
4	102	Lex	De Haan	IT_PROG
5	103	Alexander	Hunold	(null)
6	104	Bruce	Ernst	(null)
7	105	David	Austin	(null)
8	106	Valli	Pataballa	(null)
9	107	Diana	Lorentz	(null)
10	108	Nancy	Greenberg	(null)
11	109	Daniel	Faviet	(null)
12	110	John	Chen	(null)
13	111	Ismael	Sciarra	(null)
14	112	Jose Manuel	Urman	(null)
15	113	Luis	Popp	(null)
16	114	Den	Raphaely	ST_CLERK
17	115	Alexander	Khoo	(null)
18	116	Shelli	Baida	(null)
19	117	Sigal	Tobias	(null)
20	118	Guy	Himuro	(null)
21	119	Karen	Colmenares	(null)
22	120	Matthew	Weiss	(null)
23	121	Adam	Fripp	(null)
24	122	Payam	Kaufling	ST_CLERK
25	123	Shanta	Vollman	(null)
26	124	Kevin	Mourgos	(null)
27	125	Julia	Nayer	(null)
28	126	Irene	Mikkilineni	(null)
29	127	James	Landry	(null)
30	128	Steven	Markle	(null)
31	129	Laura	Bissot	(null)
32	130	Mozhe	Atkinson	(null)
33	131	James	Marlow	(null)
34	132	TJ	Olson	(null)
35	133	Jason	Mallin	(null)
36	134	Michael	Rogers	(null)
37	135	Ki	Gee	(null)
38	136	Hazel	Philtanker	(null)
39	137	Renske	Ladwig	(null)
40	138	Stephen	Stiles	(null)
41	139	John	Seo	(null)
42	140	Joshua	Patel	(null)
43	141	Trenna	Rajs	(null)
44	142	Curtis	Davies	(null)
45	143	Randall	Matos	(null)
46	144	Peter	Vargas	(null)
47	145	John	Russell	(null)
48	146	Karen	Partners	(null)
49	147	Alberto	Errazuriz	(null)

*Continued on the next page*

## Exercise Manual

50	148 Gerald	Cambrault	(null)
51	149 Eleni	Zlotkey	(null)
52	150 Peter	Tucker	(null)
53	151 David	Bernstein	(null)
54	152 Peter	Hall	(null)
55	153 Christopher	Olsen	(null)
56	154 Nanette	Cambrault	(null)
57	155 Oliver	Tuvault	(null)
58	156 Janette	King	(null)
59	157 Patrick	Sully	(null)
60	158 Allan	McEwen	(null)
61	159 Lindsey	Smith	(null)
62	160 Louise	Doran	(null)
63	161 Sarath	Sewall	(null)
64	162 Clara	Vishney	(null)
65	163 Danielle	Greene	(null)
66	164 Mattea	Marvins	(null)
67	165 David	Lee	(null)
68	166 Sundar	Ande	(null)
69	167 Amit	Banda	(null)
70	168 Lisa	Ozer	(null)
71	169 Harrison	Bloom	(null)
72	170 Tayler	Fox	(null)
73	171 William	Smith	(null)
74	172 Elizabeth	Bates	(null)
75	173 Sundita	Kumar	(null)
76	174 Ellen	Abel	(null)
77	175 Alyssa	Hutton	(null)
78	176 Jonathon	Taylor	SA_MAN
79	176 Jonathon	Taylor	SA_REP
80	177 Jack	Livingston	(null)
81	178 Kimberly	Grant	(null)
82	179 Charles	Johnson	(null)
83	180 Winston	Taylor	(null)
84	181 Jean	Fleaur	(null)
85	182 Martha	Sullivan	(null)
86	183 Girard	Geoni	(null)
87	184 Nandita	Sarchand	(null)
88	185 Alexis	Bull	(null)
89	186 Julia	Dellinger	(null)
90	187 Anthony	Cabrio	(null)
91	188 Kelly	Chung	(null)
92	189 Jennifer	Dilly	(null)
93	190 Timothy	Gates	(null)
94	191 Randall	Perkins	(null)
95	192 Sarah	Bell	(null)
96	193 Britney	Everett	(null)
97	194 Samuel	McCain	(null)
98	195 Vance	Jones	(null)

99	196 Alana	Walsh	(null)
100	197 Kevin	Feeney	(null)
101	198 Donald	OConnell	(null)
102	199 Douglas	Grant	(null)
103	200 Jennifer	Whalen	AC_ACCOUNT
104	200 Jennifer	Whalen	AD_ASST
105	201 Michael	Hartstein	MK_REP
106	202 Pat	Fay	(null)
107	203 Susan	Mavris	(null)
108	204 Hermann	Baer	(null)
109	205 Shelley	Higgins	(null)
110	206 William	Gietz	(null)

110 rows selected.

## Exercise Manual

- Joining the `jobs` and `job_history` tables, display the job title and employee ID for all jobs, whether or not they have job history.

JOB_TITLE	EMPLOYEE_ID
1 Public Accountant	101
2 Public Accountant	200
3 Accounting Manager	101
4 Administration Assistant	200
5 President	(null)
6 Administration Vice President	(null)
7 Accountant	(null)
8 Finance Manager	(null)
9 Human Resources Representative	(null)
10 Programmer	102
11 Marketing Manager	(null)
12 Marketing Representative	201
13 Public Relations Representative	(null)
14 Purchasing Clerk	(null)
15 Purchasing Manager	(null)
16 Sales Manager	176
17 Sales Representative	176
18 Shipping Clerk	(null)
19 Stock Clerk	114
20 Stock Clerk	122
21 Stock Manager	(null)

- Modify the above query to restrict the result set to jobs whose minimum salary exceeds 9000.

JOB_TITLE	EMPLOYEE_ID
1 President	(null)
2 Administration Vice President	(null)
3 Sales Manager	176



## Exercise Manual

- Joining the `jobs` and `job_history` tables, display the job title, employee ID, and starting date for all employees who started in that job after Jan. 1, 1998. Include jobs **even if** they do not have any history.

JOB_TITLE	EMPLOYEE_ID	START_DATE
1 Public Accountant	200	01-JUL-02
2 Accounting Manager	101	28-OCT-01
3 Administration Assistant	(null)	(null)
4 President	(null)	(null)
5 Administration Vice President	(null)	(null)
6 Accountant	(null)	(null)
7 Finance Manager	(null)	(null)
8 Human Resources Representative	(null)	(null)
9 Programmer	102	13-JAN-01
10 Marketing Manager	(null)	(null)
11 Marketing Representative	201	17-FEB-04
12 Public Relations Representative	(null)	(null)
13 Purchasing Clerk	(null)	(null)
14 Purchasing Manager	(null)	(null)
15 Sales Manager	176	01-JAN-07
16 Sales Representative	176	24-MAR-06
17 Shipping Clerk	(null)	(null)
18 Stock Clerk	114	24-MAR-06
19 Stock Clerk	122	01-JAN-07
20 Stock Manager	(null)	(null)

- Modify the above query: remove the start date restriction and also include the employee's first and last names.

JOB_TITLE	EMPLOYEE_ID	START_DATE	FIRST_NAME	LAST_NAME
1 Accounting Manager	101	28-OCT-01	Neena	Kochhar
2 Public Accountant	101	21-SEP-97	Neena	Kochhar
3 Programmer	102	13-JAN-01	Lex	De Haan
4 Stock Clerk	114	24-MAR-06	Den	Raphaely
5 Stock Clerk	122	01-JAN-07	Payam	Kaufling
6 Sales Representative	176	24-MAR-06	Jonathon	Taylor
7 Sales Manager	176	01-JAN-07	Jonathon	Taylor
8 Administration Assistant	200	17-SEP-95	Jennifer	Whalen
9 Public Accountant	200	01-JUL-02	Jennifer	Whalen
10 Marketing Representative	201	17-FEB-04	Michael	Hartstein
11 Marketing Manager	(null)	(null)	(null)	(null)
12 Public Relations Representative	(null)	(null)	(null)	(null)
13 Purchasing Clerk	(null)	(null)	(null)	(null)
14 Human Resources Representative	(null)	(null)	(null)	(null)
15 Accountant	(null)	(null)	(null)	(null)
16 Administration Vice President	(null)	(null)	(null)	(null)
17 Shipping Clerk	(null)	(null)	(null)	(null)
18 President	(null)	(null)	(null)	(null)
19 Stock Manager	(null)	(null)	(null)	(null)
20 Finance Manager	(null)	(null)	(null)	(null)
21 Purchasing Manager	(null)	(null)	(null)	(null)

## Exercise Manual



Bonus Section  
Do IF you  
have time...

- Joining the `employees`, `job_history`, and `jobs` tables, display the job title, employee ID, start date, and employee first and last names for ALL employees, whether or not they have any job history.

**Hint:** You will need to change the most important table.

JOB_TITLE	EMPLOYEE_ID	START_DATE	FIRST_NAME	LAST_NAME
1 Public Accountant	101	21-SEP-97	Neena	Kochhar
2 Public Accountant	200	01-JUL-02	Jennifer	Whalen
3 Accounting Manager	101	28-OCT-01	Neena	Kochhar
4 Administration Assistant	200	17-SEP-95	Jennifer	Whalen
5 Programmer	102	13-JAN-01	Lex	De Haan
6 Marketing Representative	201	17-FEB-04	Michael	Hartstein
7 Sales Manager	176	01-JAN-07	Jonathon	Taylor
8 Sales Representative	176	24-MAR-06	Jonathon	Taylor
9 Stock Clerk	114	24-MAR-06	Den	Raphaely
10 Stock Clerk	122	01-JAN-07	Payam	Kaufling
11 (null)	(null)	(null)	Sundita	Kumar
12 (null)	(null)	(null)	Diana	Lorentz
13 (null)	(null)	(null)	Nancy	Greenberg
14 (null)	(null)	(null)	Kevin	Mourgos
15 (null)	(null)	(null)	Sarath	Sewall
16 (null)	(null)	(null)	Sundar	Ande

96 (null)	(null)	(null)	John	Seo
97 (null)	(null)	(null)	Sarah	Bell
98 (null)	(null)	(null)	Nanette	Cambrault
99 (null)	(null)	(null)	Shelley	Higgins
100 (null)	(null)	(null)	David	Lee
101 (null)	(null)	(null)	Alyssa	Hutton
102 (null)	(null)	(null)	Steven	King
103 (null)	(null)	(null)	Shanta	Vollman
104 (null)	(null)	(null)	Alberto	Errazuriz
105 (null)	(null)	(null)	Valli	Pataballa
106 (null)	(null)	(null)	Stephen	Stiles
107 (null)	(null)	(null)	Peter	Tucker
108 (null)	(null)	(null)	Louise	Doran
109 (null)	(null)	(null)	Martha	Sullivan
110 (null)	(null)	(null)	Sigal	Tobias

110 rows selected.



Congratulations!  
You have finished  
this lab exercise!

## Chapter 5: Additional SQL Functions

### Exercise 5.1: Additional SQL Functions

Connect to the HR account.

- Write a query to display the department ID, first and last, names, hire date, and commission percentage of all employees with manager 100 (Steven King) whose hire date is within 2 years of Jan 1, 2007. Sequence the list in department, hire date order. Use a non-standard function to display null commissions as 0.

DEPARTMENT_ID	FIRST_NAME	LAST_NAME	HIRE_DATE	COMMISSION
50	Adam	Fripp	10-APR-2005	0
50	Shanta	Vollman	10-OCT-2005	0
50	Kevin	Mourgos	16-NOV-2007	0
80	Karen	Partners	05-JAN-2005	.3
80	Alberto	Errazuriz	10-MAR-2005	.3
80	Gerald	Cambrault	15-OCT-2007	.3
80	Eleni	Zlotkey	29-JAN-2008	.2
90	Neena	Kochhar	21-SEP-2005	0

- Change the previous query to use a standard function to display the commission percentage. This time, order the list so that those hired closest to Jan 1, 2007 are listed first.

DEPARTMENT_ID	FIRST_NAME	LAST_NAME	HIRE_DATE	COMMISSION
80	Gerald	Cambrault	15-OCT-2007	.3
50	Kevin	Mourgos	16-NOV-2007	0
80	Eleni	Zlotkey	29-JAN-2008	.2
50	Shanta	Vollman	10-OCT-2005	0
90	Neena	Kochhar	21-SEP-2005	0
50	Adam	Fripp	10-APR-2005	0
80	Alberto	Errazuriz	10-MAR-2005	.3
80	Karen	Partners	05-JAN-2005	.3



Congratulations!  
You have finished  
this lab exercise!

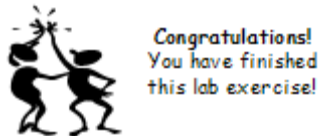
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## Chapter 6: Data Manipulation Language

### Exercise 6.1: Manipulating Data

Connect to the HR account.

1. Display all the rows in the `regions` table.
2. Add a new row for Central America. Make it ID 5.
3. Display all the rows in the `regions` table.
4. Add a new row for South America. Make it ID 6.
5. Display all the rows in the `regions` table.
6. Update all `regions` rows with the name, Central America. Change their name to South and Central America.
7. Display all the rows in the `regions` table.
8. Delete the `regions` row whose ID is 6.
9. Display all the rows in the `regions` table.
10. Issue a ROLLBACK and re-display the `regions` table.



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## Chapter 7: Databases with JDBC (Java Database Connectivity)

### Exercise 7.1: Connecting to a Database

In this exercise, you will write the Java code to connect to the database.

Over the next two days, you will enhance this project to use and test a Data Access Object (DAO), a `TransactionManager`, and a Business Service.

This exercise will complete the `SimpleDataSource` class that provides a database Connection for the DAO to use. In a real-world project, you will not be creating a `DataSource` yourself. In most situations, an application server will create a `DataSource` and make it available for application programmers to use.

For the most part, the details of our `SimpleDataSource` are not that important. The `SimpleDataSource` is not part of the actual application source code. Instead, it is in the testing section of the Eclipse project because it will only be used during testing.

To make the `SimpleDataSource` functional, you will implement the `openConnection()` method. The instructions below will show you how to do this in a Test-Driven Development (TDD) style.

1. Open the `EmployeeManagement` project in Eclipse.
  - a. Verify that the Oracle dependency is listed in `pom.xml`.

```
<dependency>
  <groupId>com.oracle.database.jdbc</groupId>
  <artifactId>ojdbc8</artifactId>
  <version>18.3.0.0</version>
</dependency>
```
2. Open the `SimpleDataSourceTest.java` file.
  - a. It is located in the `com.fidelity.integration` package in `src/test/java`.
3. Verify the `@AfterEach` method calls the `shutdown` method on the `SimpleDataSource` object.
  - a. This ensures that the database Connection is closed after each test.
4. Run the test in this file.
  - a. You should get a **Green** bar.
  - b. This shows that the `SimpleDataSource` object is successfully created.

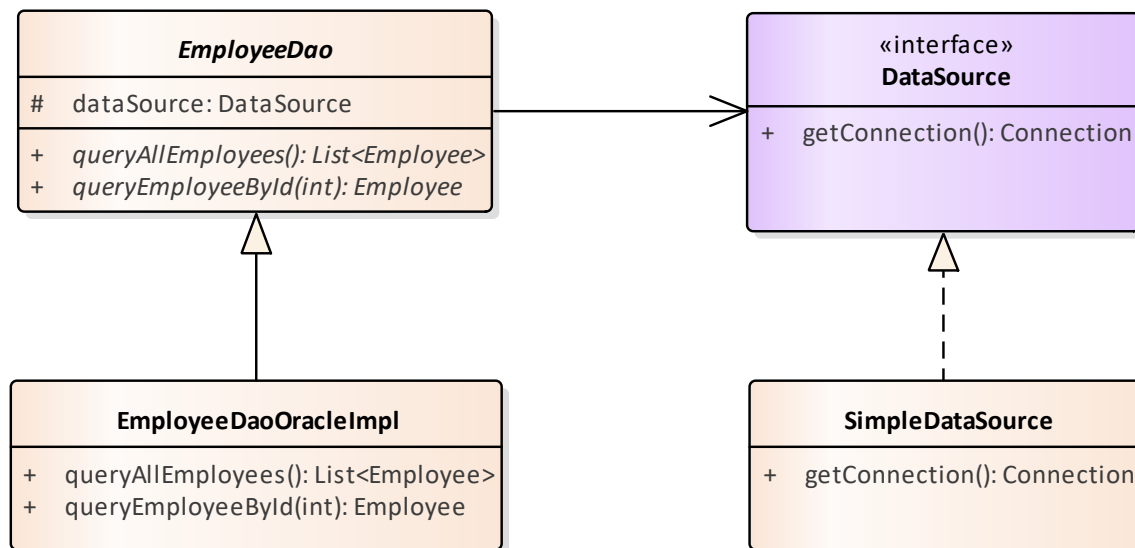
5. Open the `SimpleDataSource.java` file.
  - a. In the `com.fidelity.integration` package in `src/test/java`.
6. Examine the `openConnection()` method.
  - a. You will notice that the method is not entirely functional at this point.
  - b. The `openConnection` method is private.
  - c. The `getConnection` method calls the `openConnection` method.
7. In `SimpleDataSourceTest.java`, write a JUnit test to get a `Connection` from the `SimpleDataSource`.
  - a. By calling the `getConnection` method.
  - b. Assert that the `Connection` that is returned is not null.
  - c. Run the test.
  - d. Naturally, the test will fail!
  - e. But of course, you expected that.
  - f. **Red** bar, ...
8. Complete the `openConnection` method to return a `Connection` to the Oracle database.
  - a. Read the file `db.properties`.
    - i. This file is in the `src/main/resources` folder.
    - ii. It will be in the classpath at runtime.
  - b. Call `DriverManager.getConnection`.
  - c. If an exception occurs, throw a `DatabaseException`.
9. Run your test again.
  - a. Of course, you now get a **Green** bar because you wrote perfect code!
  - b. **Red** bar, **Green** bar, ...



## Exercise 7.2: Creating Objects from a Database Query

In this exercise, you will perform queries to access employee data from the `scott.emp` table.

The UML class diagram for this exercise is shown below:



1. Open the SQL Developer application.
  - a. View the structure of the `emp` table in the `scott` database.
  - b. In a worksheet, write a query that will select all of the records in the `emp` table.
    - i. Do **not** use `SELECT *`.
    - ii. List the columns by name in the `SELECT` statement.
2. Continue working with the `EmployeeManagement` project in Eclipse.
3. Examine the `Employee` class.
  - a. This is the Java representation of the `scott.emp` table.
4. Examine the `EmployeeDao.java` file.
  - a. Note that the class is abstract.
  - b. The two query methods are also abstract.
  - c. There is a protected `DataSource` field.

5. Create a new Java class in the `com.fidelity.integration` package to hold the database access code.
  - a. Name it `EmployeeDaoOracleImpl`
  - b. Have it extend the `EmployeeDao` base class.
  - c. Put it in the `com.fidelity.integration` package.
    - i. In all the solution projects, we will use `com.fidelity.integration` to show that it is our integration layer.
  - d. Let Eclipse write the two abstract methods inherited from the base class.
6. Now, create a test class for the `EmployeeDaoOracleImpl`.
  - a. Right-click `EmployeeDaoOracleImpl` and select **New | Other...**, then navigate to **Java | Junit** and select **Junit Test Case**.
  - b. Make sure you are creating a JUnit 5 (Jupiter) test case.
  - c. Check that the name of the class is `EmployeeDaoQueryTest`, and it is in the same package as `EmployeeDaoOracleImpl`.
  - d. Change the Source folder to `EmployeeManagement/src/test/java`.
7. Check the `@BeforeEach` and `@AfterEach` checkboxes.
8. In the `@BeforeEach` method, create a `SimpleDataSource` and an `EmployeeDaoOracleImpl` object.
9. In the `@AfterEach` methods, call the `shutdown()` method on the `SimpleDataSource` object.
10. Write a Test method to retrieve all records from the `scott.emp` table and return a list of `Employee` objects.
  - a. Work in TDD fashion.
  - b. How will you tell whether the method returned the right set of employees?
11. Run the test.
  - a. You got the **Red** bar, didn't you?
12. Write the implementation of the method in `EmployeeDaoOracleImpl`.
  - a. Use the sample code in the course notes as a guide for writing this new method.
  - b. Use the query that you created in SQL Developer.
    - i. Remember to delete the trailing ";"
  - c. Of course, you will use a `PreparedStatement`!

- d. Note that `Employee.hiredate` is a `String`. You should treat it accordingly.
  - e. Although they are not the only nullable columns, both `mgr` and `comm` have null values. JDBC will treat these as 0, which is OK for now.
13. Run the test
- a. Got the **Green** bar? Great! Go to Step 14.
  - b. Got a **Red** bar?
    - i. Read the error message.
    - ii. Do some debugging.
    - iii. Get that coveted **Green** bar.
14. Create a method to retrieve a single `scott.emp` record by `empno` and return a single `Employee` object.
- a. Again, work in TDD fashion. What tests do you need?
  - b. Write the query in SQL Developer first, then copy into the DAO method.
    - i. If a SQL statement does not work in SQL Developer, it will definitely not work in your JDBC code!
  - c. Write the tests, and then let Eclipse create the method for you.
15. Work until you get that **Green** bar.

**Optional steps, if you have time:**

16. Create a method to retrieve all the `scott.emp` records where the employee name matches a string that is passed in as a parameter. Return a list of `Employee` objects.
- a. Even though all the names are actually unique, this is not guaranteed by the database, so you should return a list, not a single `Employee` object.
17. Add a test that proves that SQL injection is not possible. Consider the string `"BobbyTables" OR '1' = '1'`.
18. Create a method to retrieve all the `scott.emp` records in a particular department and return a list of `Employee` objects.

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## Chapter 8: Updating Databases

### Exercise 8.1: Inserting a Record with JDBC

Since the `insertEmployee` method will insert a new record into the database, for testing, we should run the test in a transaction and roll back the transaction after the test has completed.

If you make significant changes to the `scott.emp` table, you can use the file `sql\emp_populate.sql` to recover the table.

In this exercise, you will use a `TransactionManager` to start and roll back a transaction.

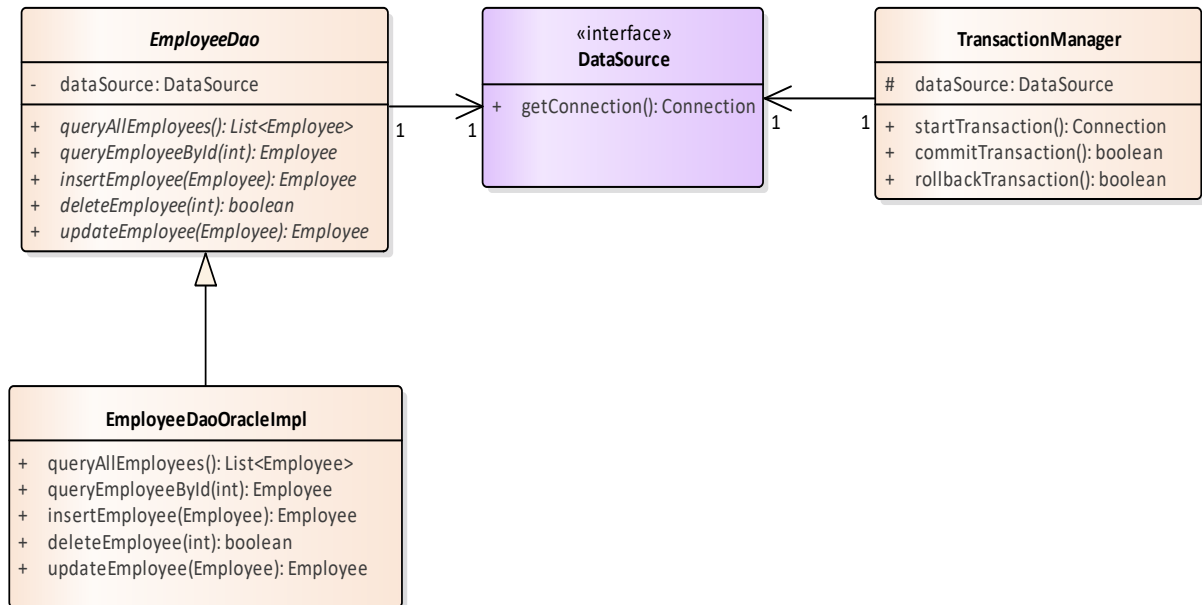
The `TransactionManager` class lives up to its name by starting, committing, and rolling back transactions.

The DAO class will not call on (or even know of) the `TransactionManager`.

1. Create a new class `TransactionManager` in the `com.fidelity.integration` package.
2. Define a constructor for `TransactionManager` that has a `DataSource` argument and initializes a data field.
3. Define the `startTransaction`, `commitTransaction`, and `rollbackTransaction` methods.
  - a. Use the `Connection` from the `DataSource` in the transaction methods.
4. Open the `EmployeeDaoDMLTest.java` file.
5. In the `@BeforeEach` method, create a new `EmployeeDaoOracleImpl` object and assign it to the DAO data member.
6. Call the `TransactionManager startTransaction()` in `@BeforeEach`.
7. Call the `TransactionManager rollbackTransaction()` in `@AfterEach`.
8. Add the `insertEmployee` method to the `EmployeeDao` base class.
9. Write a test for the `insertEmployee` method in `EmployeeDaoDMLTest`.
10. Let Eclipse write the method in `EmployeeDaoOracleImpl`.
11. Run the test to get the **Red** bar.
12. Define the new method correctly in `EmployeeDaoOracleImpl`.

## Exercise Manual

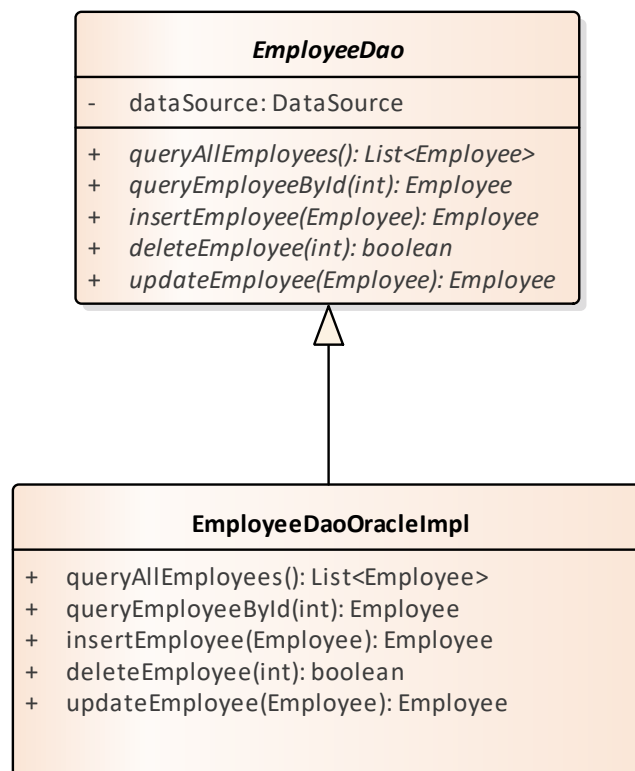
13. Run the test to get the **Green** bar.



## Exercise 8.2: Updating and Deleting Records

In this exercise, you will continue your work on the `EmployeeManagement_DML_Test` class and the `EmployeeDaoOracleImpl` class.

1. Add the abstract `updateEmployee` method to the `EmployeeDao` class.
2. Write a test for the new method.
3. Implement the new method in the `EmployeeDaoOracleImpl`.
4. Get that **Green** bar.
5. Add the `deleteEmployee` method to the `EmployeeDao` class.
6. Write a test for the new method.
7. Implement the new method in the `EmployeeDaoOracleImpl`.
8. Get that **Green** bar.
9. Write a negative test to verify the DAO throws a `DatabaseException`.
  - a. Attempt to update an employee to be in a non-existent department.
  - b. Verify the `DatabaseException` is thrown.



## Exercise 8.3: Working with Multi-Table Queries

In this exercise, you will extract information from two database tables.

In this scenario, a query will extract data from two tables. One record in each table will be involved in the query. A record in the `emp` table will be associated with one record in the `emp_perf` table.

1. Use SQL Developer to open the `emp_perf.sql` file that is in the `sql` folder in the `EmployeeManagement` Eclipse project.
2. Run the `emp_perf.sql` script.
  - a. This will create a new table named `emp_perf`.
  - b. Each record in the `emp_perf` table stores performance evaluation information for an employee.
3. Use a new worksheet in SQL Developer to create a query that will select all of the columns in a record in the `emp` table and the `perf_name` column in the `emp_perf` table for that employee.
  - a. Use a `JOIN` to obtain the data from the two tables.
  - b. Use a `WHERE` clause to specify the employee number (`empno` column).
4. In Eclipse, modify the `Employee` class to contain a `String` property to store the performance name for that employee.
  - a. This property can be null if there is no record for that employee in the `emp_perf` table.
  - b. Create the getter and setter for the new property.
  - c. Update the `equals()`, `hashCode()`, and `toString()` methods.
    - i. Ask Eclipse to do this.
5. Using TDD, define and test a new DAO method that queries for an `Employee` by `empno` including the performance property.
  - a. Set the performance property for the employee to the value in the `emp_perf` table for that employee.
  - b. Handle the situation when the employee does not have an entry in the `emp_perf` table.



## Chapter 9: Working with a Data Access Object

### Exercise 9.1: Debugging Data Access Object Methods

**Time:** 20 minutes

**Format:** Individual programming exercise

Once again, it's Friday afternoon and you are ready to pack up for a well-deserved weekend after your hard work developing a Data Access Object that utilizes JDBC.

Life is good! The weekend is almost here.

Before your weekend can start, there are a few JUnit tests that have to be examined. There are several tests, but there are two failures and one error.

Since you are now a seasoned Java and JDBC developer and debugger, you are not panicking. You know what you have to do to track the problems down and eliminate them ASAP.

1. Examine the code in the `ProblematicEmployee` project that defines the Data Access Object that is communicating with the `scott` database.
2. Run the JUnit tests for the project.
3. Notice that you get some **Green** bars but also a nasty **Red** bar indicating one error and two failures.
4. Dust off your debugging skills and get to work!
  - a. Correct one problem at a time.
  - b. You may want to use the Debugger to step through the code in order to isolate the problem.
5. Now that you have all **Green**, you are feeling pretty good.
6. Are you completely sure that your DAO code is correct?
7. Examine the set of DAO tests.
8. Are there any other tests that should be written for this DAO?
  - a. If so, you know what to do.
  - b. **Red bar**, **Green bar**, **Refactor**.

## Optional Exercise 9.2: Testing a Business Service with a Mock DAO

In this exercise, you will continue working with the `EmployeeManagement` project. You will define the `EmployeeManagementService` class and test with a mock DAO.

Now that you have a working (and tested) DAO, it is time to concentrate on how to use the DAO functionality in an application. Introducing a Business Service is a step in that direction.

The methods in the Business Service will correspond to requirements for the application that is being developed. The Business Service methods will call on the DAO to communicate with the back-end database.

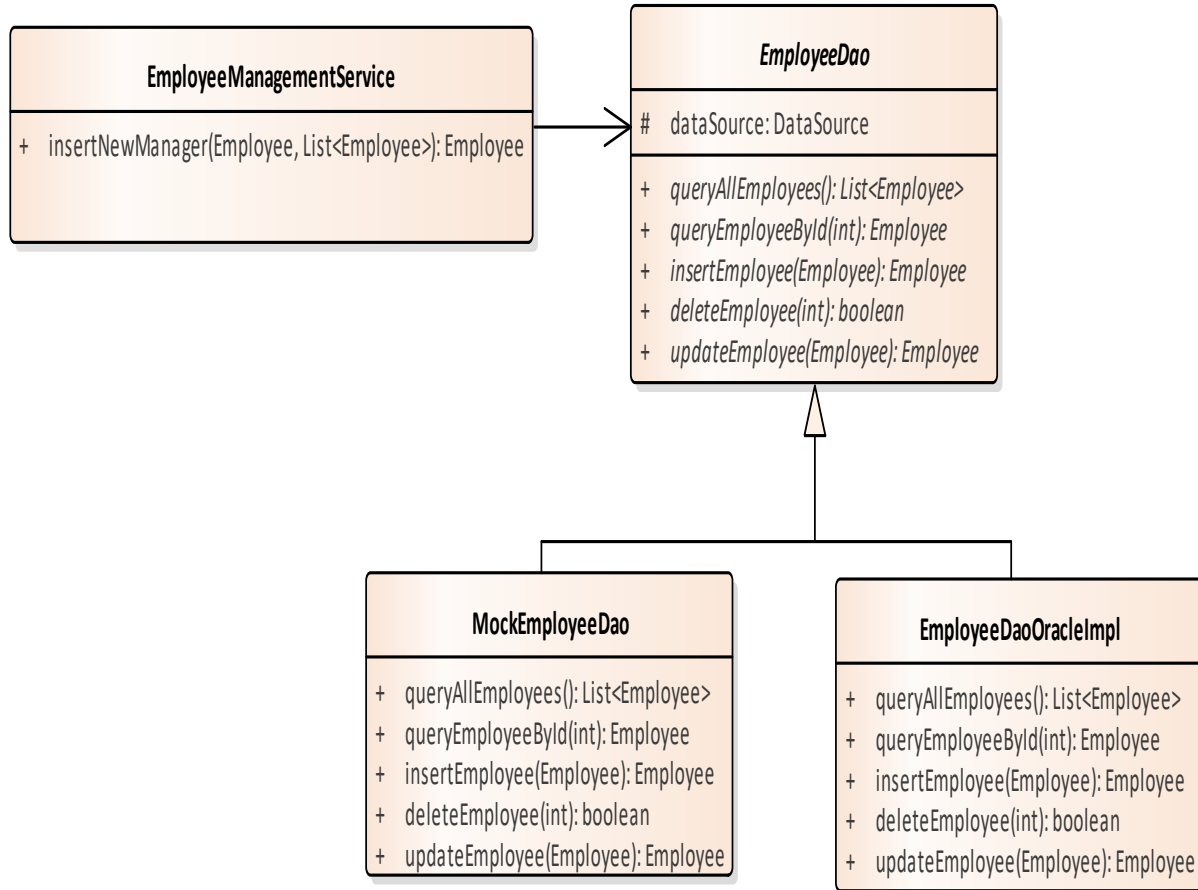
During unit testing of the Business Service, we do not want to actually modify the contents of the database. For this reason, we will use a `MockDao` that inherits from the `EmployeeDao` base class, but that does not actually communicate with the database.

The `EmployeeManagementService` will define the `insertNewManager(Manager m, List<Employee> employees)` method which will insert a new record into the `emp` table for the new Manager. It will also update the records in the `emp` table for the Employees to set the new Manager as their manager.

1. The `EmployeeManagementService` is a business service that has a dependency on the `EmployeeDao` (see the class diagram below).
2. In order to write unit tests for the `EmployeeManagementService` class, we need a mock DAO.
  - a. This is so we can test the functionality of the `EmployeeManagementService` without modifying the database.
3. Examine the `MockEmployeeDao` class that is defined at the end of the `EmployeeManagementServiceTest` class.
4. In `EmployeeManagementServiceTest`, define the `@BeforeEach` method.
  - a. Create a `MockEmployeeDao` object and assign it to the `dao` data field.
  - b. Create an `EmployeeManagementService` object passing the `dao` to its constructor.
5. Modify `MockEmployeeDao` to extend the `EmployeeDao` base class.
  - a. Add a call to `super(null)` in the constructor.
  - b. Implement the methods declared in the `EmployeeDao` base class.
    - i. Let Eclipse define them for you.

## Exercise Manual

6. Write the unit test for `insertNewManager` using the `MockEmployeeDao`.
  - a. Of course, you will do it TDD.
  - b. You may need to modify some `MockEmployeeDao` methods to return non-null values.
7. Write the `insertNewManager` method in `EmployeeManagementService`.
8. Get the **Green** bar!



## Exercise 9.3 Putting It All Together

In this exercise, you will create a new project that will contain a Data Access Object that will define methods for queries, inserts, updates, and deletes on an Oracle database.

You will define tests for all of the DAO methods. Of course, you will do this TDD style!

The tests for the DML operations will be performed in a transaction that is rolled back after the test completes.

Your instructor will provide instructions on how to import the starter project into Eclipse.

## Chapter 10: Advanced JDBC

### Optional Exercise 10.1: JDBC Code Review

You have been asked to participate in a code review of a Data Access Object that will be used in airline flight search software. The software will run in every airport check-in kiosk for a major airline.

Open the `FlightTracker` project in Eclipse.

Work in small groups to examine the code in the `FlightSearch.java` source code file.

Feel free to run the JUnit tests that are defined in the `FlightSearchTest.java` file to verify the small set of unit tests pass and produce the coveted **Green** bar.

A spokesperson for your group should be prepared to discuss the group's evaluation of the `FlightSearch` code.

In particular, your evaluation should include any positive aspects of the code (assuming there are some), and any negative aspects of the code (should there be any).

Your group should decide if you would give the `FlightSearch` code the go-ahead for inclusion in the production software installed in the airport kiosks.

If you are not giving approval of the code, then be specific as to why you would not approve of the code and what must be corrected to gain approval.

## Optional Exercise 10.2: One-to-Many Queries

In this exercise, you will once again extract data from two tables. There are two scenarios described below. In both scenarios, one `Department` object will have a collection of `Employee` objects.

One of the main challenges in this exercise is to determine how to properly process the `ResultSet` that is returned from the query.

### Scenario 1: One-to-many (1-1..\*)

In this scenario, a query will extract data from two tables. One record in the `dept` table will be associated with one to several records in the `emp` table.

1. Use SQL Developer to inspect the structure of the `dept` table in the `scott` database.
2. In your Eclipse project, create a `Department` class to store the data from a record in the `dept` table.
3. In the `Department` class, add a data field to store the `Employees` in that `Department`.
4. Using TDD, write and test a DAO method to query for a `Department` by id.
  - a. Return a `Department` object with the collection of `Employees` for that `Department`.
  - b. Use SQL Developer to help you write the query.

### Scenario 2: One-to-many (1-0..\*)

In this scenario, a query will extract data from two tables. One record in the `dept` table will be associated with zero to several records in the `emp` table. All of the records in the `dept` table are to be returned in this scenario, even if a `dept` record is not associated with any `emp` records.

5. Using TDD, write and test a DAO method that will query for all `Departments`.
  - a. Return a collection of `Department` objects with `Employees`.
  - b. Include `Departments` that do not contain any `Employees`.
  - c. Use SQL Developer to help you write the query.

## Optional Exercise 10.3: Testing a Service Proxy with Mockito

The problem is to guarantee that the DML operations provided by the DAO are called in a transaction.

While the `EmployeeManagementService` could call the `startTransaction` and `commitTransaction` methods to ensure the DML operations are performed in a transaction, that seems to leak some implementation details from the DAO into the service.

An alternative is to use a proxy for the service. This gives us the opportunity to discuss design patterns again and to demonstrate the use of one in a “real” situation.

We want the proxy to call `startTransaction` on the `TransactionManager`, then call the business service methods that are to be part of the transaction, then call `commitTransaction` on the `TransactionManager`.

The `insertNewManager()` method in the service class inserts a new `Manager` and updates the `Employees` to be managed by the new `Manager`.

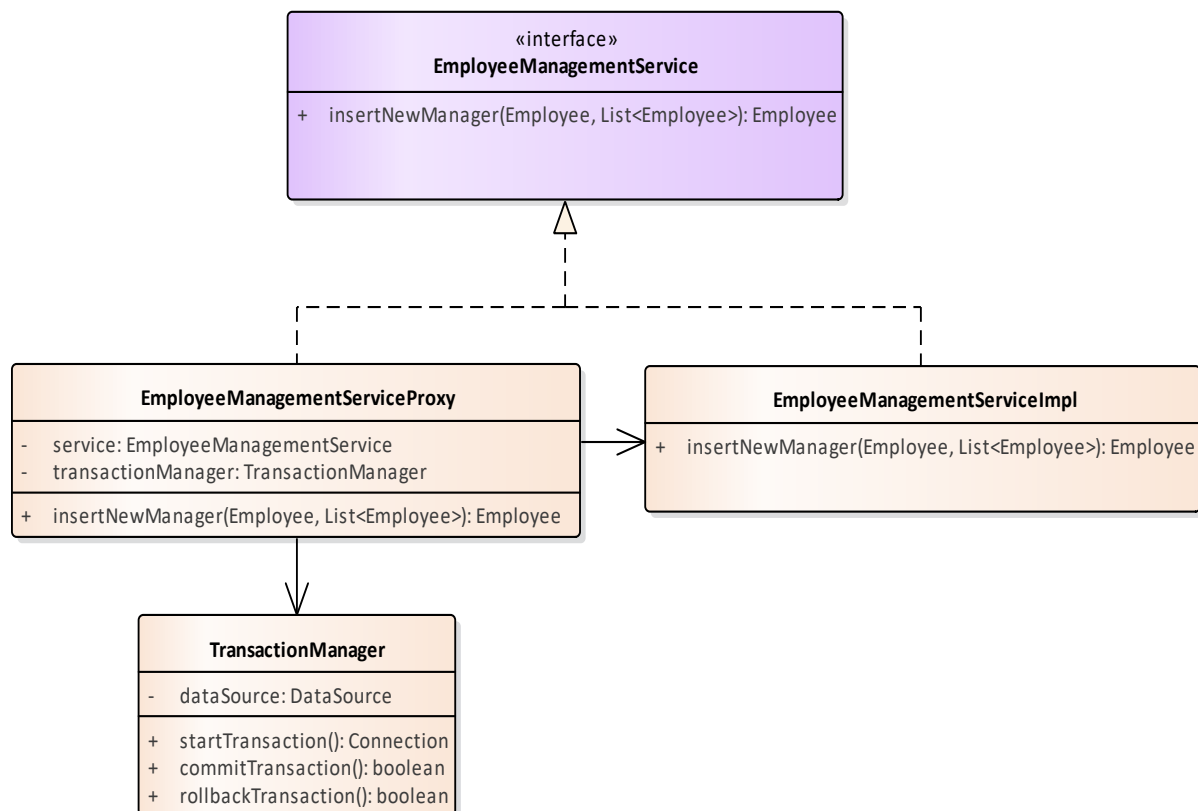
This method definitely requires a transaction to guarantee that all operations complete successfully, or all are rolled back.

If a `DatabaseException` is thrown, the proxy can let it pass on through to the client.

1. Rename the `EmployeeManagementService` class to be `EmployeeManagementServiceImpl`.
  - a. Use the **Refactor | Rename** support in Eclipse.
2. Run the tests to verify that all the tests pass.
  - a. That is what should happen when you apply Refactoring.
3. Extract the `EmployeeManagementService` interface from `EmployeeManagementServiceImpl`.
  - a. Use the **Refactor | Rename** support in Eclipse.
4. Run the tests to see that **Green** bar!
5. Create a new class named `EmployeeManagementServiceProxy`.
  - a. The `EmployeeManagementServiceProxy` class implements the `EmployeeManagementService` interface.
  - b. The `EmployeeManagementServiceProxy` class has an association with `EmployeeManagementServiceImpl`.

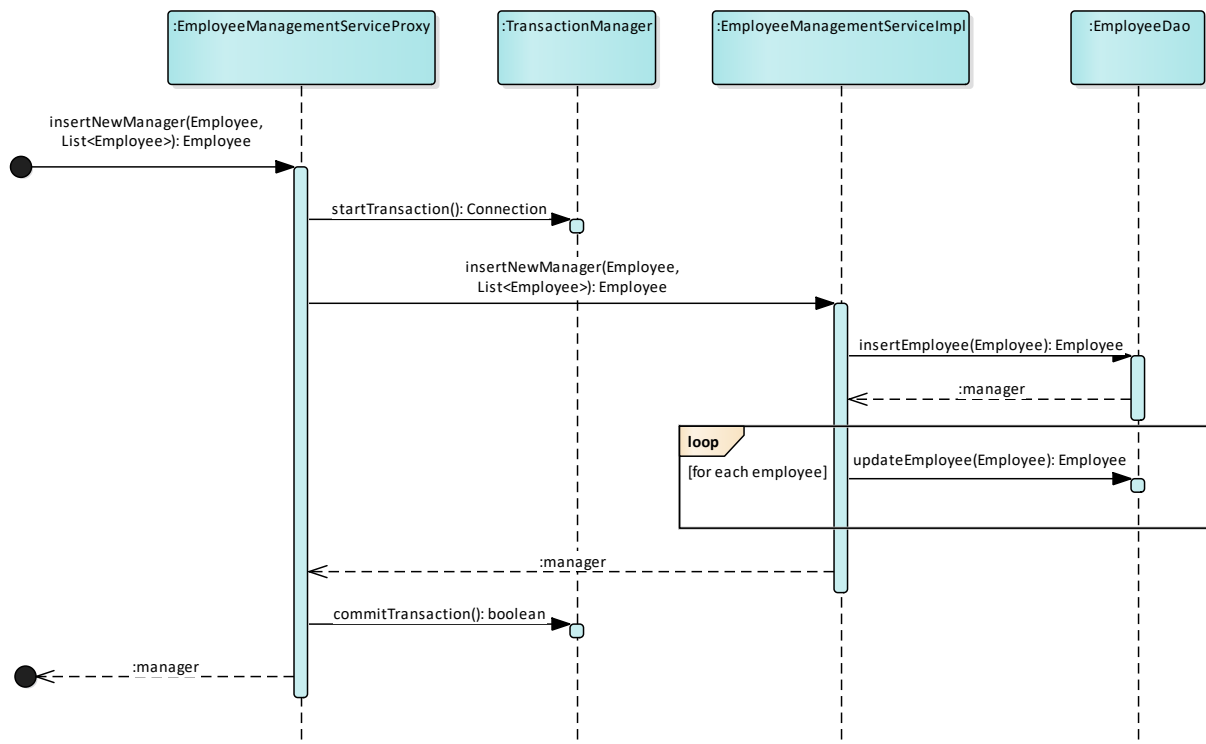
## Exercise Manual

6. Open the `EmployeeManagementServiceProxyTest.java` file.
7. Uncomment the lines of code that:
  - a. Add a data field for an `EmployeeManagementServiceProxy`.
  - b. Add a data field for a `TransactionManager`.
8. Uncomment the lines of code in the `@BeforeEach` method that create Mockito mocks for:
  - a. `TransactionManager`
  - b. `EmployeeManagementServiceProxy`
9. Write a test to verify the `startTransaction`, `commitTransaction` methods are called on the `TransactionManager` when `insertNewManager` is called on the proxy.
  - a. Use Mockito to do the verification.
  - b. Use Mockito to verify the `insertNewManager` method is called on the `EmployeeManagementServiceImpl` when `insertNewManager` is called on the proxy.





## Exercise Manual



## Optional Exercise 10.4: Writing an Integration Test for the Service and DAO

Since the `EmployeeManagementServiceImpl` class does not start a transaction directly, it is possible to test the insert, update, and delete operations and then roll the changes back in the `@AfterEach` method as you have done before.

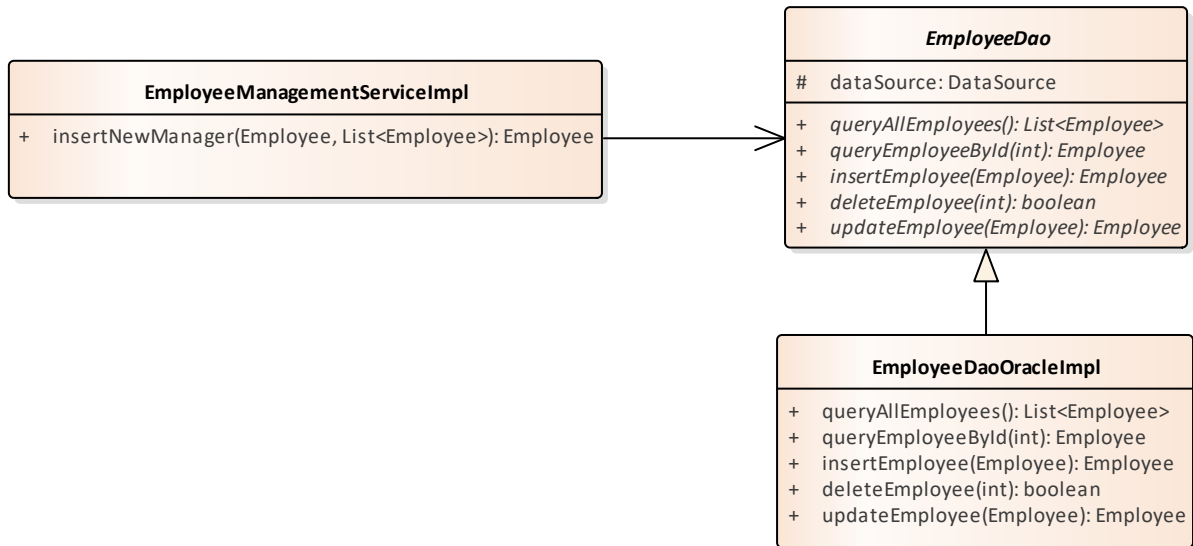
Be sure to start a transaction in the `@BeforeEach` method and to roll back the transaction in the `@AfterEach` method.

You can start and roll back the transaction as was done in the DML tests.

1. Open the `ServiceDaoIntegrationTest.java` file.
  - a. Declare a `TransactionManager` field.
2. Do the following in the `@BeforeEach` method:
  - a. Create an `EmployeeDaoOracleImpl` and assign to the `dao` field.
  - b. Create an `EmployeeManagementServiceImpl` and assign to the `service` field.
  - c. Create a `TransactionManager` and assign to the `TransactionManager` field.
  - d. Use the `TransactionManager` to start a transaction.
3. Do the following in the `@AfterEach` method:
  - a. Use the `TransactionManager` to roll back the transaction.

## Exercise Manual

4. Write an integration test for the `insertNewManager()` method.
  - a. The `EmployeeManagementServiceImpl` should call on the `EmployeeDao` to perform the necessary database operations.
  - b. In the integration test, the `EmployeeDaoOracleImpl` will be used.



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## Chapter 11: Aggregating Information

### Exercise 11.1: Using the Aggregate Functions

Connect to the SCOTT account.

- Write a query displaying how many rows there are in the emp table.

```
Count
-----
      14
```

- Write a query displaying the empno, name, salary, and commission for all rows in the emp table, sequencing the list in salary (ascending) order.

EMPNO	ENAME	SAL	COMM
7369	SMITH	800	
7900	JAMES	950	
7876	ADAMS	1100	
7521	WARD	1250	500
7654	MARTIN	1250	1400
7934	MILLER	1300	
7844	TURNER	1500	0
7499	ALLEN	1600	300
7782	CLARK	2450	
7698	BLAKE	2850	
7566	JONES	2975	
7788	SCOTT	3000	
7902	FORD	3000	
7839	KING	5000	

- Write a query displaying how many non-null salary values exist and how many distinct non-null salary values exist in the emp table.

Count	CDistinct
14	12

- Write a query displaying how many non-null commission values exists, the sum of the non-null commission values, the average of the non-null commission values for all rows in the emp table.

Count	Sum	Average
4	2200	550

- Modify the above query by adding the average of commission values treating unknown values as zero. Round this value to three decimal places.

Count	Sum	Average	Average of all Records
4	2200	550	157.143

## Exercise Manual

---

6. Write a query displaying the largest and smallest salaries in the `emp` table.

Maximum Salary	Minimum Salary
5000	800

7. Write a query displaying the latest and the earliest hire dates in the `emp` table.

Maximum Hire Date	Minimum Hire Date
12-JAN-1983	17-DEC-1980



Congratulations!  
You have finished  
this lab exercise!

## Exercise 11.2: GROUP BY and HAVING

Connect to the HR account.

- For each department in the `employees` table, show the total count of employees, the highest salary, the smallest salary, the sum of the salaries, and the average of salaries (round to the nearest whole currency unit).

DEPARTMENT_ID	COUNT(*)	MIN(SALARY)	MAX(SALARY)	Total Salary	Avg Salary
10	1	4400	4400	4400	4400
20	2	6000	13000	19000	9500
30	6	2500	11000	24900	4150
40	1	6500	6500	6500	6500
50	45	2100	8200	156400	3476
60	5	4200	9000	28800	5760
70	1	10000	10000	10000	10000
80	34	6100	14000	304500	8956
90	3	17000	24000	58000	19333
100	6	6900	12008	51608	8601
110	2	8300	12008	20308	10154
	1	7000	7000	7000	7000

*Note: Your output may not be in the same sequence.*

- Modify the presentation sequence of the above query: the departments should be in ascending average salary order.

DEPARTMENT_ID	COUNT(*)	MIN(SALARY)	MAX(SALARY)	Total Salary	Avg Salary
50	45	2100	8200	156400	3476
30	6	2500	11000	24900	4150
10	1	4400	4400	4400	4400
60	5	4200	9000	28800	5760
40	1	6500	6500	6500	6500
	1	7000	7000	7000	7000
100	6	6900	12008	51608	8601
80	34	6100	14000	304500	8956
20	2	6000	13000	19000	9500
70	1	10000	10000	10000	10000
110	2	8300	12008	20308	10154
90	3	17000	24000	58000	19333

- Modify the previous query by adding a new column: calculate how much each department's smallest salary is below the average salary. Sequence the list by this expression.

DEPARTMENT_ID	COUNT(*)	MIN(SALARY)	MAX(SALARY)	Total Salary	Avg Salary	Below Avg
20	2	6000	13000	19000	9500	3500
80	34	6100	14000	304500	8956	2856
90	3	17000	24000	58000	19333	2333
110	2	8300	12008	20308	10154	1854
100	6	6900	12008	51608	8601	1701
30	6	2500	11000	24900	4150	1650
60	5	4200	9000	28800	5760	1560
50	45	2100	8200	156400	3476	1376
40	1	6500	6500	6500	6500	0
70	1	10000	10000	10000	10000	0
10	1	4400	4400	4400	4400	0
	1	7000	7000	7000	7000	0

## Exercise Manual

4. Modify the above query by changing the analysis: we now want to know all the above information by the manager each employee works for.

MANAGER_ID	COUNT(*)	MIN(SALARY)	MAX(SALARY)	Total Salary	Avg Salary	Below Avg
100	14	5800	17000	155400	11100	5300
101	5	4400	12008	44916	8983	4583
148	6	6100	11500	51900	8650	2550
149	6	6200	11000	50000	8333	2133
147	6	6200	10500	46600	7767	1567
146	6	7000	10000	51000	8500	1500
145	6	7000	10000	51000	8500	1500
121	8	2100	4200	25400	3175	1075
108	5	6900	9000	39600	7920	1020
103	4	4200	6000	19800	4950	750
122	8	2200	3800	23600	2950	750
123	8	2500	4000	25900	3238	738
120	8	2200	3200	22100	2763	563
124	8	2500	3500	23000	2875	375
114	5	2500	3100	13900	2780	280
102	1	9000	9000	9000	9000	0
	1	24000	24000	24000	24000	0
201	1	6000	6000	6000	6000	0
205	1	8300	8300	8300	8300	0

5. Another analysis request has been made: modify the previous query to “rate” managers within each department by how far their lowest employee salary is below average.

DEPTID	MGRID	COUNT(*)	MIN(SALARY)	MAX(SALARY)	Total Salary	Avg Salary	Below Avg
80	148	6	6100	11500	51900	8650	2550
80	149	5	6200	11000	43000	8600	2400
80	100	5	10500	14000	61000	12200	1700
80	147	6	6200	10500	46600	7767	1567
80	146	6	7000	10000	51000	8500	1500
80	145	6	7000	10000	51000	8500	1500
50	100	5	5800	8200	36400	7280	1480
50	121	8	2100	4200	25400	3175	1075
100	108	5	6900	9000	39600	7920	1020
60	103	4	4200	6000	19800	4950	750
50	122	8	2200	3800	23600	2950	750
50	123	8	2500	4000	25900	3238	738
50	120	8	2200	3200	22100	2763	563
50	124	8	2500	3500	23000	2875	375
30	114	5	2500	3100	13900	2780	280
10	101	1	4400	4400	4400	4400	0
90		1	24000	24000	24000	24000	0
30	100	1	11000	11000	11000	11000	0
110	205	1	8300	8300	8300	8300	0
60	102	1	9000	9000	9000	9000	0
100	101	1	12008	12008	12008	12008	0
90	100	2	17000	17000	34000	17000	0
20	100	1	13000	13000	13000	13000	0
20	201	1	6000	6000	6000	6000	0
110	101	1	12008	12008	12008	12008	0
70	101	1	10000	10000	10000	10000	0
40	101	1	6500	6500	6500	6500	0
	149	1	7000	7000	7000	7000	0



## Exercise Manual

6. Modify the above query to show only those managers within a department that have more than 5 employees reporting to them.

DEPTID	MGRID	COUNT (*)	MIN (SALARY)	MAX (SALARY)	Total Salary	Avg Salary	Below Avg
80	148	6	6100	11500	51900	8650	2550
80	147	6	6200	10500	46600	7767	1567
80	146	6	7000	10000	51000	8500	1500
80	145	6	7000	10000	51000	8500	1500
50	121	8	2100	4200	25400	3175	1075
50	122	8	2200	3800	23600	2950	750
50	123	8	2500	4000	25900	3238	738
50	120	8	2200	3200	22100	2763	563
50	124	8	2500	3500	23000	2875	375



Bonus Section  
Do IF you  
have time...

7. Display the sum of salary, the average of salary, and the number of employees in departments, consolidating departments 0-99 together, 100-199 together, etc.

Depts by 100s	SUM (SALARY)	AVG (SALARY)	COUNT (*)
0	612500	6250	98
100	71916	8989.5	8
	7000	7000	1

8. Display the average of all departments' average salaries. Round the result to whole currency units.

Avg of Dept Avgs  
-----  
8153

9. Compare the result from the step above to the average of employee salaries. Is it the same? Why or why not?



Congratulations!  
You have finished  
this lab exercise!

## Exercise 11.3: Using Subqueries

Connect to the HR account.

*Using subqueries, write queries to display the following information:*

1. Display the department id and department name for all departments that have one or more employees. Order the result by `department_id`.

```
DEPARTMENT_ID DEPARTMENT_NAME
-----
10 Administration
20 Marketing
30 Purchasing
40 Human Resources
50 Shipping
60 IT
70 Public Relations
80 Sales
90 Executive
100 Finance
110 Accounting
```

2. Display the employee id, first name, last name, and salary for all employees that have a salary greater than the average salary for all employees. Order the result by salary in descending sequence.

```
EMPLOYEE_ID FIRST_NAME LAST_NAME SALARY
-----
100 Steven King 24000
101 Neena Kochhar 17000
102 Lex De Haan 17000
145 John Russell 14000
146 Karen Partners 13500
201 Michael Hartstein 13000
205 Shelley Higgins 12008
108 Nancy Greenberg 12008
147 Alberto Errazuriz 12000
168 Lisa Ozer 11500
148 Gerald Cambrault 11000
174 Ellen Abel 11000
114 Den Raphaely 11000
162 Clara Vishney 10500
149 Eleni Zlotkey 10500
150 Peter Tucker 10000
156 Janette King 10000
204 Hermann Baer 10000
169 Harrison Bloom 10000
170 Tayler Fox 9600
163 Danielle Greene 9500
157 Patrick Sully 9500
151 David Bernstein 9500
```

*Continued on next page*

## Exercise Manual

158	Allan	McEwen	9000
109	Daniel	Faviet	9000
103	Alexander	Hunold	9000
152	Peter	Hall	9000
175	Alyssa	Hutton	8800
176	Jonathon	Taylor	8600
177	Jack	Livingston	8400
206	William	Gietz	8300
110	John	Chen	8200
121	Adam	Fripp	8200
153	Christopher	Olsen	8000
120	Matthew	Weiss	8000
159	Lindsey	Smith	8000
122	Payam	Kaufling	7900
112	Jose Manuel	Urman	7800
111	Ismael	Sciarra	7700
154	Nanette	Cambrault	7500
160	Louise	Doran	7500
171	William	Smith	7400
172	Elizabeth	Bates	7300
164	Mattea	Marvins	7200
161	Sarath	Sewall	7000
155	Oliver	Tuvault	7000
178	Kimberely	Grant	7000
113	Luis	Popp	6900
165	David	Lee	6800
203	Susan	Mavris	6500
123	Shanta	Vollman	6500

51 rows selected.

- Display the employee id, first name, last name, and salary for the employee that has the highest salary.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY
100	Steven	King	24000

## Exercise Manual

- Display the employee id, first name, last name, salary, and commission\_pct for all employees that have a salary greater than the average salary for all employees and a commission\_pct greater than the average commission\_pct for all employees. Order the result by last\_name.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	COMMISSION_PCT
174	Ellen	Abel	11000	.3
151	David	Bernstein	9500	.25
148	Gerald	Cambrault	11000	.3
160	Louise	Doran	7500	.3
147	Alberto	Errazuriz	12000	.3
152	Peter	Hall	9000	.25
175	Alyssa	Hutton	8800	.25
156	Janette	King	10000	.35
158	Allan	McEwen	9000	.35
168	Lisa	Ozer	11500	.25
146	Karen	Partners	13500	.3
145	John	Russell	14000	.4
161	Sarath	Sewall	7000	.25
159	Lindsey	Smith	8000	.3
157	Patrick	Sully	9500	.35
150	Peter	Tucker	10000	.3
162	Clara	Vishney	10500	.25

17 rows selected.



Bonus Section  
Do IF you  
have time...

- Display the employee id, first name, and last name for the employee(s) that work in London. You will need to use two levels of subquery.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME
203	Susan	Mavris

## Chapter 12: Set Operators

### Exercise 12.1: Set Operators

Connect to the HR account.

1. Produce a short report showing the number of employees who earn commission and the number who do not.

- a. Your report should look like this:

Type	Count
-----	-----
Employees who earn commission	35
Employees who do not earn commission	72

- b. Use a set operator to create this report.



Congratulations!  
You have finished  
this lab exercise!

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## Chapter 13: Programming with PL/SQL

### Exercise 13.1: Building Anonymous Blocks

Connect to the HR account.

1. In the declaration section, declare a record `emp_rec` that uses the `employees` table as a basis.

*Use %ROWTYPE.*

2. In the executable section, retrieve information for employee with a last name of 'Austin' into `emp_rec`.
3. In the executable section, write a conditional structure that sets the new salary based on the employee's commission.

```
if commission_pct is undefined or zero then
    increase salary by a flat $500
if commission_pct is less than .2 then
    increase salary by $300
otherwise
    increase salary by $100
```

4. Write an `UPDATE` statement that sets the employee's salary to the value derived in the `IF` statement.
5. Select from the `employees` table for employee Austin to view the salary prior to running the block.
6. Execute the block. Again, query the `employees` table to check your results.

LAST_NAME	SALARY
-----	-----
Austin	5300

7. Test your code with other employees. Use Lee and then King. Validate your results by viewing the before and after values.
8. Roll back your changes.
9. Enhance your PL/SQL block by using a `CASE` statement. Execute the block and check your results. Test with other employees as in Step 6.
10. Roll back your changes.



Bonus Section  
Do IF you  
have time...

11. Enhance the block by adding exception handling. Use the block which uses the `CASE` statement. The select statement may return no rows, one row, or many rows. Add the `EXCEPTION` section and add a handler for each of the possible errors.
12. Good practice recommends that you also add a handler for any other error that may occur. If unexpected conditions occur, raise an error, display “Contact support” and append the Oracle error message.
13. Test the program by running it for different last names. Use Austin, Smith, and Howard.
14. Roll back your changes.



Congratulations!  
You have finished  
this lab exercise!



## Exercise 13.2: Using Cursors

Connect to the HR account.

In this exercise, you will declare and use a cursor to process the records in the `employees` table. Increase employee salary by \$5,000 for employees who were hired before Jan. 1, 2003. The cursor will accept one parameter, which limits the query to return only the required employees.

1. In the declaration section, declare a cursor that selects an employee record from the `employees` table. The cursor should accept one parameter called `in_date_hired`. Compare `in_date_hired` with the `date_hired` column in the `WHERE` clause of the `SELECT` statement. The cursor should include a `FOR UPDATE` clause to lock the selected rows.
2. Declare a record to hold the cursor results. Also, declare a numeric variable, `raise`, and initialize it to 5000. Finally, declare a date variable, `v_date`, and initialize it to Jan. 1, 2003.
3. In the executable section, open the cursor and pass `v_date` as a parameter.
4. Use a simple `LOOP...END LOOP` construct that loops through each record that the cursor returns.
5. Within the `LOOP`, use a `FETCH` statement to retrieve the row into the cursor record.
6. Add an `EXIT WHEN` statement to exit the loop when no more rows are returned by the cursor.

*Warning! An exit statement must be included to avoid an endless loop.*

7. Add an `UPDATE` statement, which uses the current cursor row.
8. Execute the block and check your results. Make sure to check records that should not have been updated as well!

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	HIRE_DATE	SALARY
203	Susan	Mavris	07-JUN-2002	11500
204	Hermann	Baer	07-JUN-2002	15000
205	Shelley	Higgins	07-JUN-2002	17008
206	William	Gietz	07-JUN-2002	13300
102	Lex	De Haan	13-JAN-2001	22000
108	Nancy	Greenberg	17-AUG-2002	17008
109	Daniel	Faviet	16-AUG-2002	14000
114	Den	Raphaely	07-DEC-2002	16000

8 rows selected.

## Exercise Manual

9. Roll back your changes.



Bonus Section  
Do IF you  
have time...

10. Modify the previous example to use a `FOR-LOOP` cursor instead of a regular cursor with a `LOOP`. **Set** the salary to \$11000; i.e., not a raise.

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	HIRE_DATE	SALARY
203	Susan	Mavris	07-JUN-2002	11000
204	Hermann	Baer	07-JUN-2002	11000
205	Shelley	Higgins	07-JUN-2002	11000
206	William	Gietz	07-JUN-2002	11000
102	Lex	De Haan	13-JAN-2001	11000
108	Nancy	Greenberg	17-AUG-2002	11000
109	Daniel	Faviet	16-AUG-2002	11000
114	Den	Raphaely	07-DEC-2002	11000

8 rows selected.

11. Roll back your changes.



Congratulations!  
You have finished  
this lab exercise!

## Chapter 14: Creating Stored Procedures, Functions, and Packages

### Exercise 14.1: Stored Procedures, Functions, and Packages

Connect to the HR account.

In this exercise, you will create and execute a procedure that updates an employee if one exists. Otherwise, assume this is a new employee and insert a new employee into the table.

1. Use the `CREATE PROCEDURE` statement to define a procedure called `update_emp`. It requires six input parameters: `parm_employee_id`, `parm_last_name`, `parm_email`, `parm_hire_date`, `parm_job_id` and `parm_salary`.
2. In the executable section, update the salary in the `employees` table for the specified `employee_id`. Verify that the last name, hire date, and `job_id` match the input parameters before making the change.
3. If no rows were updated because the input employee id does not exist in the `employees` table, then insert the input data into the table as a new row.
4. Complete the procedure with an `END` statement.
5. Store the procedure in the database by executing the `CREATE PROCEDURE` statement.

*If you get a warning that the procedure was created with compilation errors, use the `SHOW ERRORS` command.*

6. Test the procedure by creating a simple PL/SQL block that calls the procedure and passes parameters to it. Use employees Chen and Johnston for your tests. Check your results.
7. Roll back your changes.



Bonus Section  
Do IF you  
have time...

Change the procedure from the previous exercise to perform an `INSERT` only if the department the employee is assigned to presently has a manager.

We will use a separate function to perform the test. The function is used only by the procedure. Therefore, it can be hidden by defining it as a private function in a package.

8. Start by dropping the independent procedure `update_emp` since we now want to include it into a package.
9. Write a package specification, `pack_employee` that contains a declaration of the `update_emp` procedure. Use the `CREATE PACKAGE` statement. You will need to add one more parameter to pass in a department id.
10. Use the procedure from previous section as the basis for this procedure specification. Remember to add the additional parameter for department id. Remove the procedure body, which starts with the keyword `IS` and finishes with an `END` statement.
11. Submit the package specification to the database for compilation and storage.
12. Write the package body for `pack_employee` using the `CREATE PACKAGE BODY` statement.
13. Write a function definition in the package body. The function should return the manager id for the assigned department or a null value if a manager is not assigned. The function will require a single parameter for the `department_id`.
14. The function should be defined before the procedure.
15. Use a `FUNCTION` definition statement. The `FUNCTION` consists of a `SELECT` statement and a `RETURN` statement.
16. Copy the procedure from the previous section and make the following changes:
  - a. Add an additional parameter to pass in the `department_id`.
  - b. Add an `IF-THEN` construct around the `INSERT` statement so that it inserts only if the department being assigned to has a manager assigned.
  - c. Use a `PROCEDURE` definition statement instead of the `CREATE PROCEDURE` statement within the package body.
17. The package body must be completed with an `END` statement.
18. Submit the package body to the database for compilation and storage.

19. Test the package by executing the packaged procedure from an anonymous PL/SQL block. Check your results.



Congratulations!  
You have finished  
this lab exercise!

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## Chapter 15: Testing PL/SQL

### Exercise 15.1: Writing PL/SQL Tests with utPLSQL

Connect to the HR account.

In this exercise, you will create a function that checks whether a salary is appropriate for a given job. You will work TDD, writing tests using utPLSQL.

1. Start by creating a test package for your function.
  - a. Name it appropriately.
  - b. Annotate it with the `--%suite` annotation.
2. In the package specification, declare your first test specification.
  - a. Your test specification is a procedure annotated with `--%test`.
  - b. This will be a test for the normal behavior of the function.
3. Now create the package body for your test package.
  - a. Create the definition of the test specification.
  - b. It will pass in a known `job_id` and a `salary` in the right range, expecting boolean `TRUE`.
  - c. The body will not compile because the function under test does not exist.
4. Write the function.
  - a. It should accept two parameters, the `job_id`, and `salary`.
  - b. It should return `BOOLEAN`.
  - c. For now, it should just return `TRUE`.
5. Execute all tests in the current schema.
  - a. Turn on server output (`SET SERVEROUTPUT ON`).
  - b. Write an anonymous block that executes `ut.run()`. You can optionally pass in your test package name to ensure only that package runs.
  - c. One test will run, and it should pass.
6. Now write a second test in the test package.
  - a. It should be a test for a known `job_id` and a `salary` below the `min_salary`. It should expect `FALSE`.
  - b. Remember to add it to the package specification with the correct annotation.
7. Run the tests again. The new test should fail.
8. Now implement the appropriate functionality to return `FALSE` when the `salary` is below `min_salary` for the given `job_id` and `TRUE` otherwise.
  - a. For now, ignore exceptional situations, such as the `job_id` not existing, just focus on making the tests pass.

9. Run the tests and see that they pass.
10. Complete the normal behavior by testing for `FALSE` when the salary is above the `max_salary` for the given `job_id`.
  - a. Run the test, it should fail.
  - b. Write the functionality.
  - c. Re-run the test and repeat the cycle until it passes.
  - d. Refactor if necessary.
11. Now start to add some negative tests and implement the functionality. Write a single new test each time and then write the functionality to make it pass. Your function should behave like this:
  - a. If `job_id` or `salary` are `NULL`, it should raise an exception.
  - b. If `job_id` does not exist, it should return `FALSE`. Depending on how you wrote the function, you may not need to add any code to make this happen but add a test for it anyway.
  - c. If you think of any other exceptional situations, determine appropriate behavior and write a test.
12. Consider adding some additional boundary condition tests.



Congratulations!  
You have finished  
this lab exercise!



## Exercise 15.2: Testing Updates With utPLSQL

Connect to the HR account.

In this exercise, you will create a procedure that updates a salary for an employee if the salary is appropriate for their job.

1. Start by creating a test package for your function.
  - a. Name it appropriately.
  - b. Annotate it with the `--%suite` annotation.
2. In the package specification, declare your first test specification.
  - a. Your test specification is a procedure annotated with `--%test`.
  - b. This will be a test for the normal behavior of the procedure.
3. Now create the package body for your test package.
  - a. Create the definition of the test specification.
  - b. It will pass in a known `employee_id` and a `salary` in the right range for their `job_id`, expecting a single row to be updated.
  - c. The body will not compile because the procedure under test does not exist.
4. Write the procedure.
  - a. It should accept two parameters, `employee_id` and `salary`.
  - b. For now, it should just update the row anyway.
5. Execute your new test package.
  - a. Turn on server output (`SET SERVEROUTPUT ON`).
  - b. Write an anonymous block that executes `ut.run()`. Pass in your test package name to ensure only that package runs.
  - c. One test will run and it should pass.
6. Now write a second test in the test package.
  - a. It should be a test where the `salary` is below the `min_salary`. It should expect no rows to be updated.
  - b. Remember to add it to the package specification with the correct annotation.
7. Run the tests again. The new test should fail.
8. Now implement the appropriate functionality to ensure the `salary` is only updated when it is above the `min_salary` for the `job_id` of the employee.
  - a. If you wish, you can use the function you created in the previous exercise. Writing it as a single `UPDATE` is possible but a little harder.
  - b. For now, ignore exceptional situations, such as the `employee_id` not existing, just focus on making the tests pass.
9. Run the tests and see that they pass.

10. Complete the normal behavior by testing for no rows being updated when the salary is above the `max_salary` for the given `job_id` of the employee.
  - a. Run the test, it should fail. If you used the function in the previous steps, it may already pass. This is not a problem: the test is still valuable to protect against regression errors.
  - b. Write the functionality, if necessary.
  - c. Re-run the test and repeat the cycle until it passes.
  - d. Refactor if necessary.
  - e. Consider refactoring the tests to reduce the amount of repeated code.
11. Now start to add some negative tests and implement the functionality. Write a single new test each time, and then write the functionality to make it pass. Your procedure should behave like this:
  - a. If `employee_id` or `salary` is `NULL`, it should raise an exception.
  - b. If `employee_id` does not exist, it should simply not update any data, but it should not throw an unexpected exception (e.g., `NO_DATA_FOUND`).
  - c. If you think of any other exceptional situations, determine appropriate behavior and write a test.



Congratulations!  
You have finished  
this lab exercise!

## Chapter 16: Creating Triggers

### Exercise 16.1: Working with Triggers

Connect to the `HR` account.

In this exercise, you will write a trigger that ensures new employees are only inserted if their salary is in the right range for their job. You will use the function you created in Exercise 15.1: if you are concerned about your solution to that exercise, take the function from the solution file.

1. Check that your function has been created and that all the tests pass.
2. Create a test for inserting a new employee, expecting failure.
  - a. Note that in this case, since we are testing a trigger, the `INSERT` will occur in the test code.
  - b. Use a known unused value for the `employee_id` and `PU_CLERK` for the `job_id`. Choose a `salary` outside the right range. Set the other mandatory columns to reasonable values.
  - c. The `INSERT` should fail with an exception.
3. Run your test.
  - a. It should fail since the `INSERT` will succeed.
4. Now create an insert trigger for the `employees` table.
  - a. Use the `CREATE TRIGGER` statement.
  - b. This should be a `AFTER` trigger.
  - c. This trigger should be fired each time a row is inserted.
  - d. For now, it should just throw the exception your test is expecting.
5. Your test should now pass, but clearly, no data can be inserted into `employees`!
6. Now create a second test—this time inserting the same employee with a salary in the right range.
  - a. The test should expect the insert to succeed.
7. Run your tests. The new test should fail since the `INSERT` fails.
8. Now write the correct body of the trigger.
  - a. It should use the function to decide whether to allow the `INSERT`.
  - b. Use the `:NEW` pseudo-record to get the appropriate data values.
9. Run the tests again until they succeed.
10. When you are done, drop your trigger.

## Exercise Manual

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Bonus Section  
Do IF you  
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11. Modify your trigger, so it also works for an `UPDATE` of `job_id` or `salary`.
  - a. Have it throw a different exception when performing an `UPDATE`.
  - b. Work TDD.
12. Drop your trigger.



Congratulations!  
You have finished  
this lab exercise!

## Chapter 17: Data Definition Language

### Exercise 17.1: Table Management

Connect to the HR account.

In this exercise, you will create a new table, a sequence, and a view. Using these, you will explore various DDL commands and their effects.

1. Create a table called `benefits`.
  - a. Use the following columns definitions:

```
benefit_id          NUMBER(3)      NOT NULL
benefit_name        VARCHAR2(25)
benefit_type        VARCHAR2(20)  DEFAULT 'HEALTH CARE'
benefit_effective_date DATE
benefit_max_allowance NUMBER(8,2)
```
  - b. Make `benefit_id` the primary key.
2. Describe the `benefits` table to verify the definition.
3. Create a sequence called `seq_benefits`. Make its starting and incremental values 1.
4. Insert a row into the `benefits` table *without* a column list.
  - a. Use the sequence for the `benefit_id`.
  - b. Make the name "401k", the type "Retirement", set the effective date to Jan. 1, 2010, and the max allowance to 250,000.
5. Insert another row into the `benefits` table *with* a column list, specifying *all* columns.
  - a. Use the sequence for the `benefit_id`.
  - b. Make the name "Medical PPO", the type "Health", set the effective date to Jan. 1, 2011, and the max allowance to 100,000.
6. Insert another row into the `benefits` table *with* a column list, specifying *all* columns.
  - a. Use the sequence for the `benefit_id`.
  - b. Set the type to the reserved word `DEFAULT`.
  - c. Make the name "Medical Ins", set the effective date to Jan. 1, 2012, and the max allowance to 125,000.
7. Display all the rows in the `benefits` table. What is the value of type for the 3<sup>rd</sup> row?

8. Insert another row into the `benefits` table with a column list. Specify all column names except for `benefit_type`.
  - a. Use the sequence for the `benefit_id`.
  - b. Make the name "No default name provided", set the effective date to Jan. 1, 2013, and the max allowance to 150,000.
9. Display all the rows in the `benefits` table. What is the value of type for the 4th row?
10. Update all benefits rows whose type value begins with "H" to the table `DEFAULT`.
11. Display all the rows in the `benefits` table. What is the value of the type columns?
12. `COMMIT` the changes.
13. Create a view called "vw\_h\_b" that contains the benefit ID, name, type, and max allowance from the `benefits` table. Only allow the rows whose value for type begins with "HEALTH".
14. Describe this view.
15. Display all the rows through the view.
16. Try to add a new, numeric, mandatory column to the `benefits` table: `max_dependents`. Why did the attempt fail?
17. Try to add the column again, this time specifying a `DEFAULT` value of 0.
18. Display the `benefits` table: what value is in the `max_dependents` column?
19. Re-run the select through the view. Does it include the new column?



Bonus Section  
Do IF you  
have time...

20. Modify the maximum size of the `benefit_name` column to be 50. Does this succeed?
  - a. Describe the `benefits` table to see the impact of the command.
21. Try to modify the maximum size of the `benefit_name` column to be 20. Why does this fail?

22. Insert into the `benefits` table by selecting all the rows from the `benefits` table.
  - a. Use the row values for all columns except for the `benefit_id`: use the sequence number for this value.
23. Display all the rows in the `benefits` table. How many are there now?
24. Issue a `ROLLBACK`.
25. Re-run the previous set insert.
  - a. Insert into the `benefits` table by selecting all the rows from the `benefits` table.
  - b. Use the row values for all columns except for the `benefit_id`: use the sequence number for this value.
26. Display all the rows in the `benefits` table. How many are there now? What are the benefit IDs? Can you explain their values?



Congratulations!  
You have finished  
this lab exercise!

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## Chapter 20: Amazon DynamoDB

### Exercise 20.1: Access DynamoDB Using AWS CLI

In this exercise, you will use a local version of DynamoDB and the AWS Command Line Interface to explore basic DynamoDB actions. You will first create a simple table and then add some data to it, before using various actions to query the data.

1. Use Visual Studio Code for this exercise.
  - a. Unzip the file `dynamodb.zip` into a folder on your desktop.
    - i. *Note:* running exercise from any other than the `C:\` drive will NOT work.
  - b. Open that folder in VS Code.
2. Open a terminal window and examine `start.bat`.
  - a. This file runs the local version of DynamoDB.
  - b. Run the file by entering: `.\start.bat` (*Note:* do not forget `\".\"`.)
  - c. Leave that terminal window open.
3. Open a new terminal window to use for the rest of the exercise.
4. Run the command: `aws configure`.
  - a. Do not change the Access Key or Secret Access Key, instead just press Return.
  - b. Enter a suitable region, choose `us-east-1`, `eu-west-1` or `ap-south-1`, depending on your location.
  - c. You can also press return and leave the output format unset.
5. Run the command:  

```
aws dynamodb create-table --generate-cli-skeleton input
```
6. Compare the output from that command to the contents of the file `CreateTable.json`.
  - a. The output of the previous command is a pro forma for the `CreateTable` action.
  - b. The file `CreateTable.json` creates a table called `Music` with a two-part key (`artist` and `songTitle`).

7. Run the following command and check the output:

```
aws dynamodb create-table \  
  --endpoint-url http://localhost:8000 \  
  --cli-input-json file://CreateTable.json
```

- Replace the backslash (\) with the appropriate line continuation character for your terminal, or type the command on one line.
- Make sure not to forget the `--endpoint-url` parameter or the `file://` protocol on the `--cli-input-json` parameter.
- Normally, you would need to wait for the table to become active, but since we are using the local version of DynamoDB, it becomes active immediately.

8. Run these commands to see your new table:

```
aws dynamodb list-tables \  
  --endpoint-url http://localhost:8000  
  
aws dynamodb describe-table \  
  --endpoint-url http://localhost:8000 \  
  --table-name Music
```

9. Run the command:

```
aws dynamodb put-item --generate-cli-skeleton input
```

- Again, the output is a pro forma for the `PutItem` action.
- Note that this pro forma contains a number of legacy items. Consult the documentation to see which items those are:  
[https://docs.aws.amazon.com/amazondynamodb/latest/APIReference/API\\_PutItem.html](https://docs.aws.amazon.com/amazondynamodb/latest/APIReference/API_PutItem.html)

10. Add some data to your table:

```
aws dynamodb put-item \  
  --endpoint-url http://localhost:8000 \  
  --cli-input-json file://PutItem1.json  
  
aws dynamodb put-item \  
  --endpoint-url http://localhost:8000 \  
  --cli-input-json file://PutItem2.json
```

- Note that the two files do not set the same attributes on both items.

## 11. Try different ways of retrieving data (review each file before you run it):

```
aws dynamodb get-item \  
  --endpoint-url http://localhost:8000 \  
  --cli-input-json file://GetItem.json  
  
aws dynamodb query \  
  --endpoint-url http://localhost:8000 \  
  --cli-input-json file://Query.json  
  
aws dynamodb scan \  
  --endpoint-url http://localhost:8000 \  
  --cli-input-json file://Scan.json
```



Bonus Section  
Do IF you  
have time...

12. Try other variations of these commands; for example, you can also insert an item using this version of the `PutItem` action:

```
aws dynamodb put-item \  
  --endpoint-url http://localhost:8000  
  --table-name Music \  
  --item file://item.json \  
  --return-values ALL_OLD
```

- a. It won't return any data unless you run it twice because the contents of `item.json` are a new item.
- b. You could also specify the item at the command line in either JSON or shorthand format.

13. Using your own data, add new items to the `Music` table and write `GetItem`, `Query`, and `Scan` commands to retrieve them.

Congratulations!  
You have finished  
this lab exercise!

## Exercise 20.2: Java Document API

In this exercise, you will access DynamoDB from Java code and investigate how to achieve the same basic tasks using the Java Document API.

1. Make sure the local version of DynamoDB is running, as described at the start of the previous exercise.
2. Use Eclipse for the rest of the exercise.
3. Open the `DynamoDB` project in the Relational Databases workspace.
4. Open `DynamoDbDocumentDao` and `DynamoDbDocumentDaoTest`.
  - a. Review the tests and corresponding code.
  - b. Compare them to the files used for the previous exercise.
5. Run the tests. They should all pass.
6. Take a copy of `music.json`.
  - a. Do not edit the existing file since it is used by a number of test classes.
  - b. Change the contents of your new JSON file to reflect some of your own musical choices.
  - c. Edit `DynamoDbDocumentDaoTest` to refer to the new file.
  - d. Make the tests pass with your new data.



Bonus Section  
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have time...

7. Open `DynamoDbLowLevelDao` and `DynamoDbDaoLowLevelTest`. These use the low-level API.
  - a. Review the code and compare them to the Document versions.
  - b. Especially look at features that you know to be different, such as waiting for asynchronous operations, converting to and from Java classes, and iterating over windowed collections.



Congratulations!  
You have finished  
this lab exercise!

## Exercise 20.3: Java Object Mapper

In this exercise, you will continue accessing DynamoDB using Java, but this time you will access data using the Java Object Mapper. You will see how to achieve tasks such as inserting and querying data using this higher-level interface.

1. Make sure the local version of DynamoDB is running, as described at the start of the previous exercise.
2. In the `DynamoDB` project, open `DynamoDbMapperDao` and `DynamoDbMapperDaoTest`.
  - a. Review the tests and corresponding code.
  - b. Compare them to the files used for the previous exercise.
3. Run the tests. They should all pass.
4. Take a copy of `music.json`.
  - a. Do not edit the existing file since it is used by a number of test classes.
  - b. Change the contents of your new JSON file to reflect some of your own musical choices.
  - c. Edit `DynamoDbMapperDaoTest` to refer to the new file.
  - d. Make the tests pass with your new data.



Congratulations!  
You have finished  
this lab exercise!