INFO90002 Tutorial Week 7 SOLUTIONS

Objectives

- Learn how to use the following SQL keywords: FORMAT, ROUND
- Learn how to join two tables together with INNER JOIN and NATURAL JOIN
- Learn how to write sub queries
- Learn to use maths operators
- Learn how to use SQL keywords: HAVING, UNION

Formatting & Rounding

FORMAT(X,D) and ROUND(X,D) are functions you can use to improve the readability of a query result. Round will round the argument – what is in the parenthesis "X" to D decimal places. Format will format the argument to D decimal places and include commas.

```
SELECT AVG(Salary) AS AVG_SAL
FROM Employee;

60529.411765

SELECT FORMAT(AVG(SALARY),2) AS AVG_SAL
FROM Employee;

60,529.41

SELECT ROUND(AVG(SALARY),2) AS AVG_SAL
FROM Employee;
60529.41
```

N.B.: *FORMAT and ROUND while producing the same output are different. FORMAT converts the output into a STRING (hence the 60<comma>529), whereas round keeps the result as a NUMBER*

NATURAL JOINS and INNER JOINS

Typically, relational database management systems have many entities in a database schema. To retrieve all the necessary data, tables frequently need to be joined together. Table joins can take many forms in SQL. They include Natural Join, Inner Join, Right Join, Left Join, Outer Join. We will now look at the Natural and Inner joins in SQL.

NATURAL JOIN

Natural Joins work when the joining column name is identical in both tables that are being joined together.

```
SELECT table1.column1, table1.column2, table2.column1
FROM table1 NATURAL JOIN table2
```

Consider the department table:

DepartmentID	Name	Floor	Phone	ManagerID
1	Management	5	34	1
2	Books	1	81	4
3	Clothes	2	24	4
4	Equipment	3	57	3
5	Furniture	4	14	3
6	Navigation	1	41	3
7	Recreation	2	29	4
8	Accounting	5	35	5
9	Purchasing	5	36	7
10	Personnel	5	37	9
11	Marketing	5	38	2
NULL	NULL	NULL	NULL	NULL

And the employee table:

EmployeeID	FirstName	LastName	Salary	DepartmentID	BossID	DateOfBirth
1	Alice	Munro	125000.00	1	NULL	1966-12-14
2	Ned	Kelly	85000.00	11	1	1970-07-16
3	Andrew	Jackson	55000.00	11	2	1958-04-01
4	Clare	Underwood	52000.00	11	2	1982-09-22
5	Todd	Beamer	68000.00	8	1	1965-05-24
6	Nancy	Cartwright	52000.00	8	5	1993-04-11
7	Brier	Patch	73000.00	9	1	1981-10-16
8	Sarah	Fergusson	86000.00	9	7	1978-11-15
9	Sophie	Monk	75000.00	10	1	1986-12-15
10	Sanjay	Patel	45000.00	6	3	1984-01-28
11	Rita	Skeeter	45000.00	2	4	1988-02-22
12	Gigi	Montez	46000.00	3	4	1992-03-20
13	Maggie	Smith	46000.00	3	4	1991-04-29
14	Paul	Innit	41000.00	4	3	1998-06-02
15	James	Mason	45000.00	4	3	1995-07-30
16	Pat	Clarkson	45000.00	5	3	1997-08-28
17	Mark	Zhang	45000.00	7	3	1996-10-01
NULL	NULL	NULL	NULL	NULL	NULL	NULL

The departmentID column is common to both tables. There is a foreign key (departmentID) in the employee table that references the primary key (departmentID) in the department table.

To find the department name for each employee we would need to retrieve the name from the department table and firstname and lastname from the employee table (joined over departmentID).

```
SELECT department.name, employee.firstname, employee.lastname
FROM employee NATURAL JOIN department;
```

The result set would be:

name	firstname	lastname
Management	Alice	Munro
Books	Rita	Skeeter
Clothes	Gigi	Montez
Clothes	Maggie	Smith
Equipment	Paul	Innit
Equipment	James	Mason
Furniture	Pat	Clarkson
Navigation	Sanjay	Patel
Recreation	Mark	Zhang
Accounting	Todd	Beamer
Accounting	Nancy	Cartwright
Purchasing	Brier	Patch
Purchasing	Sarah	Fergusson
Personnel	Sophie	Monk
Marketing	Ned	Kelly
Marketing	Andrew	Jackson
Marketing	Clare	Underwood

Because each column name in the SELECT command is unique to the query, the department name and employee names could also be written without the table name prefacing the column name:

```
SELECT name, firstname, lastname
FROM employee NATURAL JOIN department;
```

Natural Joins work when the column name is identical in BOTH name and purpose for the two tables being joined together. However, there are times when the column names are identical - but the meaning is different, and they refer to different characteristics.

For example, both the department and item tables have a column called *name*. But the purpose is different. The name column in the department table is the department's name and the name column in the item table is the item's name. Yet despite there being no PK-FK relationship between item and department tables the following statement:

```
SELECT itemid, departmentID
FROM item NATURAL JOIN department;
```

is parsed and executed. It returns 0 rows because there are no common names in the respective name columns of the item and department table. The MySQL database server does **not** return an error because the SQL is *syntactically* correct although it is *logically* incorrect.

INNER JOIN

Inner Joins are always used when the joining column names are not identical. Inner Joins provide an explicit definition of what the join condition is. INNER JOIN must always be joined using the ON syntax which specifies the join condition.

Syntax for an INNER JOIN is the following (note the ON clause):

```
SELECT table1.column1, table1.column2, table2.column2
FROM table1 INNER JOIN table2
ON table1.column1 = table2.column4;
```

Inspect the earlier Department / Employee name query now rewritten as an Inner Join:

```
SELECT name, firstname, lastname
FROM department INNER JOIN employee
ON department.departmentID = employee.departmentID;
```

The INNER JOIN syntax explicitly states what column should join the two tables, whereas the NATURAL JOIN is implicit. The query using an Inner Join explicitly states the join is on the departmentID column in both the department and employee tables.

1) **TASK** List each employee's full name and the department name they work in. Order the result by department name

   This query requires you to join the Department table to the Employee table. Use the Physical data model to work out if you need to do a NATURAL JOIN or an INNER JOIN

```
SELECT name, firstname, lastname
FROM department NATURAL JOIN employee
ORDER BY name;
```

Alternatively, you could format the query for better readability

```
SELECT name as Department_name,
CONCAT(firstname, ' ',lastname) as Employee_name
FROM department NATURAL JOIN employee
ORDER BY name;
```

Alternatively using an INNER JOIN

```
SELECT name as Department_name,CONCAT(firstname, ' ',lastname)
as Employee_name
FROM department INNER JOIN employee
ON department.DepartmentID = employee.DepartmentID
ORDER BY name;
```

name	Employee_name
Accounting	Todd Beamer
Accounting	Nancy Cartwright
Books	Rita Skeeter
Clothes	Gigi Montez
Clothes	Maggie Smith
Equipment	Paul Innit
Equipment	James Mason
Furniture	Pat Clarkson
Management	Alice Munro
Marketing	Ned Kelly
Marketing	Andrew Jackson
Marketing	Clare Underwood
Navigation	Sanjay Patel
Personnel	Sophie Monk
Purchasing	Brier Patch
Purchasing	Sarah Ferguson
Recreation	Mark Zhang

2) **TASK** Type a query to find the first and last name of all the employees in in the Management department. Then test your written SQL in MySQL Workbench

Your result set should look like this:

firstname	lastname
Alice	Munro

```
SELECT firstname, lastname
FROM employee NATURAL JOIN department
WHERE name ='Management';
```

3) **TASK** Type the query to list the Supplier name and the number of deliveries made to the department store

```
SELECT Supplier.Name, COUNT(Delivery.DeliveryID) as
numDeliveries
FROM supplier NATURAL JOIN delivery
GROUP BY supplier.Name;
```

Name	Deliveries
All Points Inc.	3
All Sports Manufacturing	2
Global Books & Maps	3
Nepalese Corp.	3
Sao Paulo Manufacturing	4
Sweatshops Unlimited	1

In this SQL we have prefaced each column with its table name for readability. This format is always

```
TABLENAME.COLUMNNAME
```

Sub Queries

Sometimes we need to find a value and then use it. For example if we wanted to find out the departmentid of the department which has the lowest salary.

First we would find the lowest salary across all of the department store.

You might be tempted to write a query like this

```
SELECT min(Salary), DepartmentID
FROM Employee;
```

But if we check this result set we will see that this result is wrong.

```
SELECT min(salary)
FROM Employee
WHERE DepartmentID =1;
```

OR

```
SELECT min(Salary), DepartmentID
FROM Employee
GROUP BY DepartmentID;
```

Department 1 does not have the lowest salary! While we can use the LIMIT keyword – it is not wise to do so and is to be avoided if possible.

We can break the problem into two components. Find the lowest salary, then find the departmentid rows where the salary matches the value of the first query.

```
SELECT MIN(Salary)
FROM Employee;
```

The result set is one value {41000} we then use that value in our next query

```
SELECT DepartmentID
FROM Employee
WHERE Salary = 41000;
```

This can be done in the one statement:

```
SELECT departmentid
FROM Employee
WHERE SALARY =
     (SELECT MIN(Salary)
      FROM Employee);
```

	departmentid
	4

The query in parenthesis is known as the "inner query" and the other query is known as the "outer query".

This is doing exactly the same as the two individual SQL statements above it but in one statement. The query in parenthesis is run first and the result returned (41000). Then each row in the outer query evaluates the salary value with the value returned in the inner query (41000). The only match is where Department ID is 4.

Important: *if the subquery returns more than one result "=" will not work you must use "IN"*

4) How many employees work in departments located on the fifth floor?

To approach this question, we break it into separate components.

1. What departmentid's are on the fifth floor?
2. Count the number of employees whose departmentid matches the results returned in the inner query who are in the same department as the first query

Query 1 The "inner" query

```
SELECT departmentid
FROM Department
WHERE Floor = 5;
```

	departmentid
	1
	8
	9
	10
	11

Returns the result set {1,8,9,10,11} that is five rows.

Now we need to count each row in the Employee table where the departmentID matches 1 or 8 or 9 or 10 or 11.

As the result set has more than one row we need to use the keyword IN

```
SELECT COUNT(employeeid)
FROM Employee
WHERE departmentid IN
     (SELECT departmentID
      FROM Department
      WHERE Floor = 5);
```

	EMP_COUNT_FLOOR5
	9

TRY: If you have time replace the keyword IN with" =" and observe the error in the query window:

Error Code: 1242. Subquery returns more than 1 row

Just remember to do a NATURAL J OIN between two tables they must share the same column name and data type.

Multiple table joins

When we join more than two tables, the same principles apply, there must be a common column between the two entities functioning as a Primary Key / Foreign Key referential integrity.

5) TASK Find the sale dates of all types of tents

Using a NATURAL JOIN

```
SELECT item.name, sale.saledate, SUM(saleitem.quantity)
FROM item NATURAL JOIN saleitem NATURAL JOIN sale
WHERE item.name like 'TENT%'
GROUP BY item.name, sale.saledate;
```

Remember, using a NATURAL JOIN both tables need to have columns of the same name, data type and purpose.

And written using INNER JOIN

```
SELECT item.name, sale.saledate, SUM(saleitem.quantity)
FROM item INNER JOIN saleitem INNER JOIN sale
ON item.itemid = saleitem.itemid
AND saleitem.saleid = sale.saleid
WHERE item.name LIKE 'TENT%'
GROUP BY item.name, sale.saledate;
```

name	saledate	SUM(saleitem.quantity)
Tent - 2 person	2017-10-14	1
Tent - 2 person	2017-10-15	1
Tent - 2 person	2017-10-24	1
Tent - 2 person	2017-10-25	2
Tent - 8 person	2017-08-19	1
Tent - 8 person	2017-12-14	1
Tent - 4 person	2017-10-15	1

HAVING clause

The HAVING clause acts like a WHERE clause but it identifies groups meeting a criterion, rather than rows. A HAVING clause usually follows a GROUP BY clause

6) List the department names with more than 2 employees

```
SELECT department.name, COUNT(employee.employeeid)
FROM department NATURAL JOIN employee
GROUP BY department.name
HAVING COUNT(employee.employeeid) > 2;
```

name	count(employee.employeeid)
Marketing	3

Remember that WHERE works on rows, HAVING works on aggregates (e.g. COUNT, AVG, SUM etc.)

7) **TASK** Find the item id's sold by at least two departments on the second floor

```
SELECT DISTINCT ItemID
FROM sale INNER JOIN saleitem INNER JOIN department
ON sale.SaleID = saleitem.SaleID
AND sale.DepartmentID = department.DepartmentID
WHERE department.Floor=2
GROUP BY ItemID
HAVING COUNT(DISTINCT(department.Departmentid)) > 1;
```

Alternatively

```
SELECT DISTINCT ItemID
FROM sale INNER JOIN saleitem INNER JOIN department
ON sale.SaleID = saleitem.SaleID
AND department.DepartmentID = sale.DepartmentID
WHERE department.DepartmentID IN
      (SELECT DepartmentID
      FROM department
      WHERE department.Floor=2)
GROUP BY ItemID
HAVING COUNT(DISTINCT(department.Departmentid)) > 1
ORDER BY ItemID;
```

N.B.: There are other ways of achieving the same result set.

	ItemID
	14

Remember: If necessary review the slides from the week 5 lecture on the types of joins.

8) **TASK TASK** Type the query to list the departments that have an average salary over $55000

```
SELECT DepartmentID, AVG(employee.Salary)
FROM employee
GROUP BY DepartmentID
HAVING AVG(employee.Salary) > 55000;
```

1.2 Continued

You can format the output for better readability:

```
SELECT DepartmentID,
FORMAT(AVG(employee.Salary),2) AS AverageSalary
FROM employee
GROUP BY DepartmentID
HAVING AVG(employee.Salary) > 55000;
```

DepartmentID	AverageSalary
1	125.000.00
8	60.000.00
9	79.500.00
10	75.000.00
11	64.000.00

Remember that HAVING is the way to use a condition for any column that has an aggregate function used on it (e.g. AVG MAX SUM COUNT etc)

9) **TASK** Type the name of items which have only been delivered by exactly one supplier

HINT: You will need to join three tables (Item, Sale and Department) together and make sure the ambiguous columns in your select statement are fully qualified e.g.:

SELECT employee.Lastname, department.Name

FROM employee NATURAL JOIN department

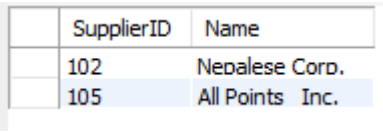
```
SELECT item.Name, COUNT(DISTINCT(SupplierID)) as SupplierCount
FROM deliveryitem INNER JOIN delivery INNER JOIN item
ON deliveryitem.DeliveryID = delivery.DeliveryID
AND deliveryitem.ItemID = item.ItemID
GROUP BY item.Name
HAVING COUNT(distinct(supplierID)) = 1
ORDER BY  item.Name;
```

Name	SupplierCount
BBQ - Jumbuk	1
Boots - Mens Hiking	1
Boots - Womens Goretex	1
Boots - Womens Hiking	1
Boots Riding	1
Camping chair	1
Cowboy Hat	1
Horse saddle	1
Polar Fleece Beanie	1
Sun Hat	1
Tent - 2 person	1
Tent - 4 person	1
Tent - 8 person	1

10) **TASK** List the suppliers that have delivered at least 10 distinct items. List the supplier name and id

```
SELECT Supplier.SupplierID, Supplier.Name
FROM deliveryitem INNER JOIN supplier INNER JOIN delivery
ON deliveryitem.DeliveryID = delivery.DeliveryID
AND delivery.SupplierID = supplier.SupplierID
GROUP BY supplier.SupplierID
```

```
HAVING COUNT(DISTINCT deliveryitem.ItemID) >= 10;
```



SupplierID	Name
102	Nepalese Corp.
105	All Points Inc.

11) TASK Type the SQL that for each item, gives its type, the departments that sell the item, and the floor location of these departments.

HINT: You will need to join four tables (Item, SaleItem, Sale and Department) together and make sure each ambiguous column in your select statement is fully qualified e.g.:

SELECT Employee.lastname, Department.Name

FROM Employee Natural Join Department

```
SELECT DISTINCT(item.Name), item.Type, sale.DepartmentID,
department.Floor
FROM item INNER JOIN saleitem INNER JOIN sale INNER JOIN
department ON item.ItemID = saleitem.ItemID
AND saleitem.SaleID = sale.SaleID
AND sale.DepartmentID = department.DepartmentID
ORDER BY item.Name, sale.DepartmentID;
```

Your result set should look something like this:

Name	Type	DepartmentID	Floor
BBQ - Jumbuk	F	4	3
Boots - Mens Hiking	C	3	2
Boots - Womens Goretex	C	3	2
Boots - Womens Hiking	C	3	2
Boots Riding	C	2	1
Camping chair	F	4	3
Compass - Silva	N	2	1
Compass - Silva	N	4	3
Compass - Silva	N	6	1
Cowboy Hat	C	3	2
Exploring in 10 Easy Les...	B	2	1
Geo positioning system	N	2	1
Geo positioning system	N	6	1
Gortex Rain Coat	C	2	1
Gortex Rain Coat	C	3	2
Gortex Rain Coat	C	4	3
Gortex Rain Coat	C	5	4
Gortex Rain Coat	C	6	1
How to Win Foreign Frie...	B	2	1
How to Win Foreign Frie...	B	6	1
Map case	E	6	1
Map measure	N	6	1
Pocket knife - Essential	E	2	1
Pocket knife - Essential	E	3	2
Pocket knife - Essential	E	4	3
Pocket knife - Essential	E	5	4
Pocket knife - Essential	E	6	1
Pocket knife - Essential	E	7	2
Polar Fleece Beanie	C	3	2
Sun Hat	C	3	2
Tent - 2 person	F	7	2
Tent - 4 person	F	7	2
Tent - 8 person	F	7	2
Torch	E	2	1
Torch	E	3	2
Torch	E	4	3
Torch	E	5	4
Torch	E	6	1

12) TASK Name the items that are delivered by Nepalese Corp **or** sold in the Navigation department

```
SELECT DISTINCT(item.Name)
FROM item
WHERE ItemID IN
      (SELECT ItemID
       FROM deliveryitem NATURAL JOIN delivery NATURAL JOIN
      Supplier
       WHERE supplier.Name = 'Nepalese Corp.')
OR ItemID IN
      (SELECT ItemID
       FROM saleitem NATURAL JOIN sale NATURAL JOIN department
       WHERE department.Name = 'Navigation');
```

UNION

You could also use the UNION clause

A UNION Join includes all data from each table that is joined. The columns selected in a UNION join must be the same.

```
SELECT DISTINCT item.Name
FROM item
WHERE ItemID IN
      (SELECT ItemID
      FROM deliveryitem NATURAL JOIN delivery NATURAL JOIN
      supplier
      WHERE supplier.Name = 'Nepalese Corp.')
UNION
      (SELECT item.Name
      FROM saleitem NATURAL JOIN sale
      NATURAL JOIN department NATURAL JOIN item
      WHERE department.Name = 'Navigation');
```

N.B.: The second SELECT clause matches the first SELECT clause, both choosing item.name. To use separate column information use UNION ALL

	Name
	Compass - Silva
	Exploring in 10 Easy Lessons
	Geo positioning system
	How to Win Foreign Friends
	Map case
	Map measure
	Gortex Rain Coat
	Pocket knife - Steadfast
	Pocket knife - Essential
	Camping chair
	BBQ - Jumbuk
	Torch
	Tent - 2 person
	Tent - 8 person
	Tent - 4 person

END OF TUTORIAL 7

Appendix New Department Store Physical ER Model