Parallel and distributed systems

SQL assignment

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Q0. Can you describe the series of steps to open a database for querying?

1. Open *MySQL* and type your password:

   ```
   mysql -u root -p
   ```

2. In order to explore the available databases, type:

   ```
   mysql> show databases;
   ```

3. To choose a specific database, for instance called *A*, type:

   ```
   mysql> use A;
   ```

Q1. What is the purpose of this query?

```
mysql> SELECT * from Sources;
```

It provides us with all the table entries of the table called *Sources*.

```
+--------+-------------+
| exptId | source      |
+--------+-------------+
| 1      | Pancreas    |
| 2      | Liver       |
| 4      | Human Liver |
+--------+-------------+
3 rows in set (0,00 sec)
```

Q2. Get 5 *GenBank* ids and corresponding *descriptions*.

```
mysql> SELECT gbId, description FROM Descriptions LIMIT 5;
```

```
+--------+-----------------------------------------+
| gbId   | description                             |
+--------+-----------------------------------------+
| A00142 | granulysin                              |
| A00146 | lypase, gastric                         |
| A03911 | seryne (or cysteine) proteinase inhibitor |
| A06977 | albumin                                 |
| A12027 | S100 calcium binding protein A8         |
+--------+-----------------------------------------+
5 rows in set (0,00 sec)
```

Q3. What is the purpose of this query?

```
mysql> SELECT count(*) from LocusLinks;
```

It counts the total number of entries in the table *LocusLinks*.

```
+----------+
| COUNT(*) |
+----------+
|       22 |
+----------+
1 row in set (0,00 sec)
```

Q4. How many different *Affy* ids are in the expression data?

```
mysql> SELECT COUNT(affyId) FROM Data;
```

```
+---------------+
| COUNT(affyId) |
+---------------+
|            37 |
+---------------+
1 row in set (0,00 sec)
```

Q5. What is the expression level of *Affy* id *U95-32123_at* in experiment number 1?

```
mysql> SELECT level FROM Data WHERE affyId="U95-32123_at" AND exptId=1;
```

```
+-------+
| level |
+-------+
|   128 |
+-------+
1 row in set (0,00 sec)
```

Q6. Find all the gene *descriptions*, along with their *GenBank* ids containing the word "*Human*"?

```
mysql> SELECT * FROM Descriptions WHERE description LIKE "%Human%";
```

gbId	description
A12345	HSLFBPS7 Human fructose-1, 6-biphosphatase
A12346	HSU30872 Human mitosin mRNA
A12347	HSU33052 Human lipid-activated protein kinase
A12348	HSU33053 Human lipid-activated protein kinase
A12349	Human clone lambda 5 semaphorin mRNA
A22124	Human rearranged immunoglobulin lambda light chain mRNA
A22127	Human rearranged immunoglobulin lambda light chain mRNA

7 rows in set (0,00 sec)

Q7. What *Gene Ontology descriptions* (and corresponding *accession*) contain the phrase "*protein kinase*"? Answer should be provided in ascending order of accessions.

```
mysql> SELECT * FROM GO_Descr WHERE description LIKE "%protein kinase%"
mysql> ORDER BY goAcc ASC;
```

goAcc	description
0001236	protein kinase
0001237	protein kinase
1112222	protein kinase
4442222	protein kinase

4 rows in set (0,00 sec)

Q8. Which *AffyId* of table *Data* correspond to sequences in *Targets* table with the phrase "*kinase*" in their *description*?

```
mysql> SELECT Data.affyId FROM Data, Targets, Descriptions
mysql> WHERE Data.affyId=Targets.affyId
mysql> AND Targets.gbId=Descriptions.gbId
mysql> AND Descriptions.description LIKE "%kinase%";
```

Empty set (0,00 sec)

Use the following command:

```
LOAD DATA INFILE ‘file.tsv’ INTO TABLE Targets;
```

To add a new entry in *Descriptions* with the string "*kinase*" and the *gbId="M18228"*. Now repeat the query again.

Repeating the same query again is still showing 0 results. There is an *affyId* corresponding to the *gbId* that we have introduced (*M18228*), but that *affyId* is not in the *Data* table.

```
Empty set (0,00 sec)
```

Q9. Get two *affyId*, *uId* and *descriptions* in *LocusDescr* in reverse alphabetical order of *descriptions*.

```
mysql> SELECT Targets.affyId, UniSeqs.uId, LocusDescr.description
mysql> FROM LocusDescr, LocusLinks, Targets, UniSeqs
mysql> WHERE UniSeqs.gbId=LocusLinks.gbId AND Targets.gbId=LocusLinks.gbId
mysql> AND LocusLinks.linkId=LocusDescr.linkId ORDER BY description DESC LIMIT 2;
```

```
+-------------+--------+-------------+
| affyId      | uId    | description |
+-------------+--------+-------------+
| U95_40474_at | Hs1691 | Glucan      |
| U95_32123_at | Hs1640 | Collagen    |
+-------------+--------+-------------+
2 rows in set (0,01 sec)
```

Q10. How would you find the average expression level of each experiment in *Data*?

```
mysql> SELECT exptId, AVG(level) FROM Data GROUP BY exptId;
```

```
+--------+------------+
| exptId | AVG(level) |
+--------+------------+
| 1      |   125.3333 |
| 2      |    95.3333 |
| 3      |   126.3333 |
| 4      |    83.5000 |
| 5      |    92.7500 |
| 6      |    18.3333 |
| 7      |    20.0000 |
| 8      |    40.0000 |
| 9      |    20.0000 |
+--------+------------+
9 rows in set (0,00 sec)
```

Q11. What is the average expression level of each array probe (affyId) across all experiments?

```
mysql> SELECT affyId, AVG(level) FROM Data GROUP BY affyId;
```

affyId	AVG(level)
31315_at	250.0000
31324_at	91.0000
31325_at	89.0000
31356_at	91.0000
31362_at	260.0000
31510_s_at	257.0000
5321_at	90.0000
5322_at	90.0000
5323_at	90.0000
5324_at	73.5000
5325_at	90.0000
AFFX-BioB-3_at	97.0000
AFFX-BioB-5_at	20.0000
AFFX-BioB-M_at	62.8000
AFFX-HSAC07/X00351_M_at	86.0000
AFFX-HUMBAPDH/M33197_3_st	277.0000
AFFX-HUMTFFR/M11507_at	90.0000
AFFX-M27830_3_at	271.0000
AFFX-MurIL10_at	6.6667
AFFX-MurIL2_at	20.0000
AFFX-MurIL4_at	49.0000
U95-32123_at	128.0000
U98-40474_at	57.0000

23 rows in set (0,00 sec)

Q12. What is the purpose of the following query?

```
mysql> SELECT Data.affyId, Data.level, Data.exptId, DataCopy.affyId,
mysql> DataCopy.level, DataCopy.exptId
mysql> FROM Data, Data DataCopy
mysql> WHERE Data.level > 10 * DataCopy.level
mysql> AND Data.affyId=DataCopy.affyId
mysql> AND Data.affyId LIKE "AFFX%''
mysql> LIMIT 10;
```

From the table called "*Data*" it takes the entries with an *affyId* beginning with the string "*AFFX*". Then, it selects those whose levels are ten times higher than the levels of other experiments of the same *affyId*. Finally, it shows up the first ten matchs.

```
+----------------+-------+--------+----------------+-------+--------+
| affyId         | level | exptId | affyId         | level | exptId |
+----------------+-------+--------+----------------+-------+--------+
| AFFX-BioB-M_at |   214 | 5      | AFFX-BioB-M_at |    20 | 3      |
| AFFX-BioB-M_at |   214 | 5      | AFFX-BioB-M_at |    20 | 7      |
| AFFX-BioB-M_at |   214 | 5      | AFFX-BioB-M_at |    20 | 9      |
+----------------+-------+--------+----------------+-------+--------+
3 rows in set (0,00 sec)
```

Q13. Write a query to provide three different descriptions for all gbId in table Targets

There are four tables containing descriptions. Therefore, there are 4 possible combinations and 4 possible outputs, depending on which three tables are chosen (*Descriptions*, *LocusDescr*, *GO_Descr* or *UniDescr*). One of the possibilities is the following one:

```
mysql> SELECT Targets.gbId, Descriptions.description AS General_Description,
mysql> LocusDescr.description AS Locus_Description,
mysql> GO_Descr.description AS GO_Description
mysql> FROM Targets, Descriptions, LocusDescr, LocusLinks, GO_Descr, Ontologies
mysql> WHERE Descriptions.gbId=Targets.gbId
mysql> AND Targets.gbId=LocusLinks.gbId AND LocusLinks.linkId=LocusDescr.linkId
mysql> AND LocusLinks.linkId=Ontologies.linkId
mysql> AND Ontologies.goAcc=GO_Descr.goAcc;
```

```
+--------+---------------------+-------------------+----------------+
| gbId   | General_Description | Locus_Description | GO_Description |
+--------+---------------------+-------------------+----------------+
| S75295 | Glucan              | Glucan            | Glucan Enz     |
+--------+---------------------+-------------------+----------------+
1 row in set (0,00 sec)
```

Q14. Write a query to provide all gene ontology (GO_descr) descriptions related with all species in table Species sorted alphabetically and providing the first five results. Export the query to a tab-separated-file with the command:

```
mysql> SELECT * FROM TABLE INTO OUTFILE 'data.out';
```

```
mysql> SELECT GO_Descr.description, Targets.species
mysql> FROM GO_Descr, Ontologies, LocusLinks, Targets
mysql> WHERE GO_Descr.goAcc=Ontologies.goAcc
mysql> AND Ontologies.linkId=LocusLinks.linkId
mysql> AND LocusLinks.gbId=Targets.gbId
mysql> ORDER BY GO_Descr.description ASC LIMIT 5
mysql> INTO OUTFILE '14.out';
```

```
+-----------------------------------------+---------+
| description                             | species |
+-----------------------------------------+---------+
| extracellular space                     | Hs      |
| fructose-2, 6-biophosphatase 2-phosphatase | Hs      |
| Glucan Enz                              | Hs      |
| protein kinase                          | Hs      |
| protein kinase                          | Hs      |
+-----------------------------------------+---------+
5 rows in set (0,00 sec)
```