Homework Assignment #3
Database Systems – Semester A 2025/2026

Due 15/01/2026

Submission Instructions

Your final submission should contain a zip file containing all submission requirements and a details.txt file that should contain the ID and name of each submitting student, such as:

first_name last_name 123456789
first_name last_name 987654321

- The zip file should be named with your ID, such as $'123456789.zip'$. If multiple students submit, separate the ID numbers with an underscore, such as $'123456789\_987654321.zip'$.

- In this assignment, your zip file needs to contain 1 .pdf file and the proper python files for creating the database and the tables.

- Submission is through the course website and can be either individually or in pairs:

  - If you submit in pairs, only one of the two should submit, and that student will also be the one to receive feedback.

  - A submission for three people is not permitted. If you cannot find a pair, you should submit by yourself (it is not necessary to ask for permission to submit by yourself).

Requirements

For each query, you are required to submit a single file called `q{n}.py` if the question contains a single query (for example, `q1.py`, `q2.py`, etc.), or `q{n_m}.py` (for example, `q2_1.py`, `q2_2.py`, etc.) for each query in the question. That will include the following:

- The Python code and SQL query you used.

- Documentation - mandatory. Use `#` to add comments.

- For all queries each of the python files need to be in the format:

Listing 1: Python file format example

```python
import mysql.connector

if __name__ == '__main__':
    mydb = mysql.connector.connect(
        host="localhost",
        user="root",
        password="root",
        database="="## PUT THE CORRECT DATABASE HERE IF
    NEEDED ##",
        port='3307',
    )
    cursor = mydb.cursor()
    cursor.execute("""
    ## PUT YOUR QUERY ##
    """)
# !!!Commit the transaction to save the changes to the
    database!!!
mydb.commit()
cursor.close()
mydb.close()
```

Important Notes

- Do not use commands that have not yet been learned or will not be learned at all.
  All of the required commands have already been learned by the time of posting this exercise.
  If a query uses such commands, all points will be deducted.

- Please make sure that the queries are well formatted (use the syntax conversion learned in class.) to make them readable (see the example format below).

Part A - ERD

The purpose of this part is to design and ERD, translate it into relational schema, create a database and the proper tables in SQL.

Background Story

You will design a schema to track after patients-disease-doctor, Hosppdd. A new patient who registers at the hospital provides his/her details -unique ID, name, height, weight, gender. When registering, a patient can have one previous disease. In addition, a patient is always diagnosed with one new disease. Disease consists of a unique disease ID, name, and severity. A disease is treated with one medicine. A medicine has a unique ID, and a name. The same medicine can treat many diseases. A patient is being taken care of by one of the doctors in a hospital, but a doctor can take care of several patients. A hospital has a unique ID and a name. Each doctor is registered to a hospital based on a unique doctor ID. This ID is unique per hospital. For example, there can be two doctors with ID 1 in two different hospitals, but there can't be two doctors with ID 1 in the same hospital. A doctor also has a name. In addition, every doctor has another doctor assigned to consult him. Each patient is asked to rate the doctor who took care of him. The basic rating contains a unique rating id and a rating. There's a more enhanced type of rating which is called an "opinion"- here the rater can also write a short comment, in addition to the rating.

Question 1:

Create an ER diagram describing all the required entity sets, the relationships between them and constraints on these entities and relationships (keys, referential integrity, etc.).

- Keep your design simple but faithful to the scenario.

- You may add titles to the connecting lines where you think it may be helpful for clarity.

- There may be some requirements the ER diagram is not able to model. Use the ERD tools you have learned to create entity sets, attributes and relationships diagram to best describe the scenario.

- Make sure each entity set has a unique identifier (key).

- You can use any tool you like to create the diagram (power point, visio, graphical software, a scanned page in clear handwriting, ...) but the symbols must be as learned in class

- Do NOT submit an EER diagram created through MySQL Workbench!

Question 2:

Translate the diagram into a relational schema. Provide the table names, column names, the key(s) of each table and the foreign keys between tables in the following example format:
University(name, ranking, address)
Student(ID, name, studies_at)
foreign key:
Student(studies_at) → University(name)
...

Question 3:

In SQL, create a database and the proper tables (submit your queries in Python as previous assignments)

Part B - Normalizations

In this part for every lossless decomposition you should fill out the following 2 tables as the (there could be more rows than what is written below):

Table 1: Decomposition Table

Step Number	Violating Table	Violating FD	Result Table 1	Result Table 2
1				
2				
3				
4				
5				

Table 2: Final Result Table

Result Table	All Minimal Keys

Question 4:

Alice got the relation $R(A, B, C, D, E)$ with the following functional dependencies:

$A, B \rightarrow C$
$C, D \rightarrow E$

She decomposed it into $R1(A, B, C)$ and $R2(A, B, D, E)$.
A) Is the result of Alice's decomposition in BCNF? Explain briefly.
B) Is the result of Alice's decomposition in 3NF? Explain briefly.
C) Is the result of Alice's decomposition dependency preserving? If not, give a counter example. Explain briefly.

Question 5:

You are given a relation $R(A, B, C, D, E, F, G)$ with the following functional dependencies:

$C, A \rightarrow G$
$F \rightarrow C$
$G \rightarrow E, B$
$G \rightarrow A$

$B, C \rightarrow D$
$D \rightarrow B$
A) Find all the minimal keys for R.
B) Decompose R into BCNF using the lossless decomposition algorithm we have learned in class. Show all the decomposition steps, write the FD you decompose on, and provide (all) the minimal keys of the output relations. (Fill the tables).
C) Write which of the original FDs have lost from the decomposition if any?

Question 6:

You are given a relation $R(A, B, C, D, E, F, G)$ with the following functional dependencies:
$G \rightarrow A$
$A, D \rightarrow B$
$B \rightarrow C, E$
$E, A \rightarrow F$
$F \rightarrow B$
A) Find all the minimal keys for R.
B) Decompose R into BCNF using the lossless decomposition algorithm we have learned in class. Show all the decomposition steps, write the FD you decompose on, and provide (all) the minimal keys of the output relations. (Fill the tables).
C) Write which of the original FDs have lost from the decomposition if any?

Question 7:

You are given a relation $R(A, B, C, D, E, F, G)$ with the following functional dependencies:
$A, C \rightarrow D$
$D \rightarrow F, E$
$F \rightarrow C, G$
$B, G \rightarrow D$
A) Find all the minimal keys for R.
B) Decompose R into BCNF using the lossless decomposition algorithm we have learned in class. Show all the decomposition steps, write the FD you decompose on, and provide (all) the minimal keys of the output relations. (Fill the tables).

C) Does the original relation R have an FD that violates BCNF but not 3NF?

Question 8:

You are given a relation $R(A, B, C, D, E)$ with the following functional dependencies:
$A \rightarrow C$
$B \rightarrow D$
$C, D \rightarrow E, B$
A) Find all the minimal keys for R B) Decompose R into BCNF using the lossless decomposition algorithm we have learned in class. Show all the decomposition steps, write the FD you decompose on, and provide (all) the minimal keys of the output relations. (Fill the table). C) Does the original relation R have an FD that violates BCNF but not 3NF?

Question 9:

You are given the table $R(A, B, C)$ with the following functional dependencies:
$A \rightarrow B$
$B, C \rightarrow A$
C) Can you decompose R into BCNF with dependency preserving? Yes/No and explain.