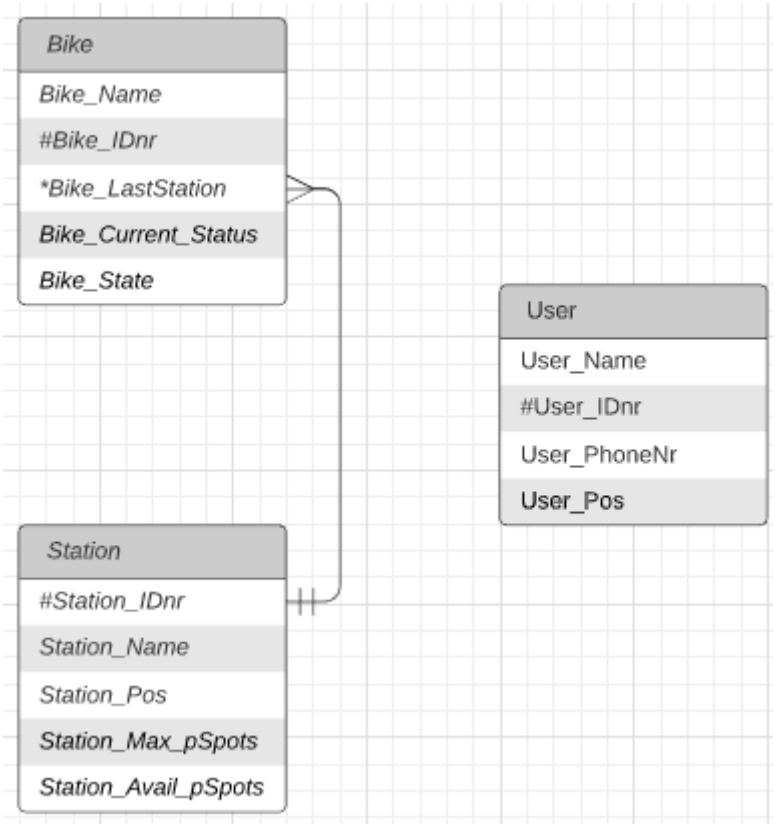
Problem 1. (10%)

1.1 Create an ER diagram from the description given above. The diagram should represent the entities and their attributes. Mark primary and foreign keys, and include relational arrows

Solution:



1.2 Given the current three entities, do all three tables contain a relationship. Example: does a user own a bike?

Solution:

All three tables do *not* contain a relationship. The User table is independent of what the other two tables are. All attributes of the User table are not referenced to or by any key.

Problem 2. (20%)

1.1 What is the problem with the proposed solution? Are there unwanted dependencies if we add the attributes that the junior developer proposes? Identify the problem.

Solution:

A subscription can only have one user, but a user can have multiple subscriptions (active and inactive subscriptions) and becomes a problem when added to the User entity. It should instead have its own entity.

It is the same with the phone number for example where multiple users cannot have the same phone number. The phone number can only have one user, the user can have multiple phone numbers.

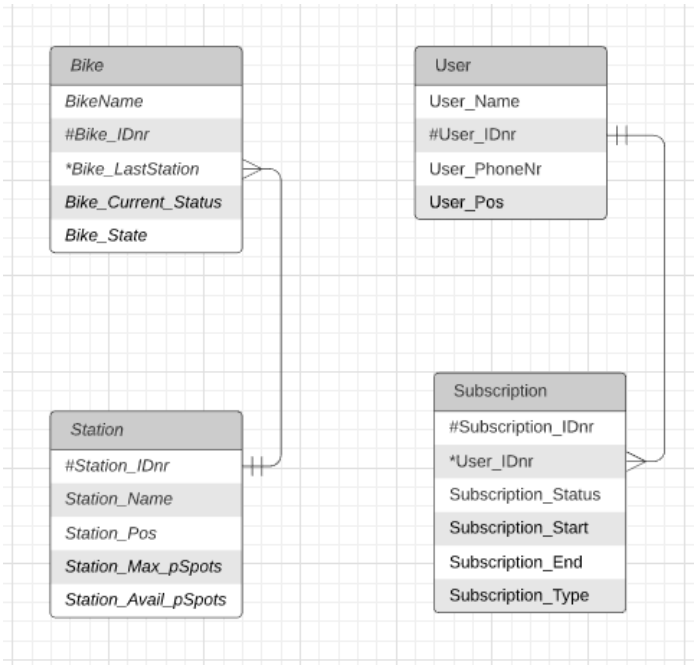
1.2 Create table / tables to solve the problem. Mark primary keys, and foreign keys.

Solution:

We create another table called Subscription to handle the subscriptions of the user. Then we reference the User_IDnr with a foreign key to the primary key in User_IDnr. Thus, the problem is solved.

1.3 Based on the tables created, produce the extended ER diagram. Include appropriate primary, foreign keys and relations.

Solution:



Problem 3. (25%)

1.1 Identify the attributes in the database description above and create a table.

Solution:

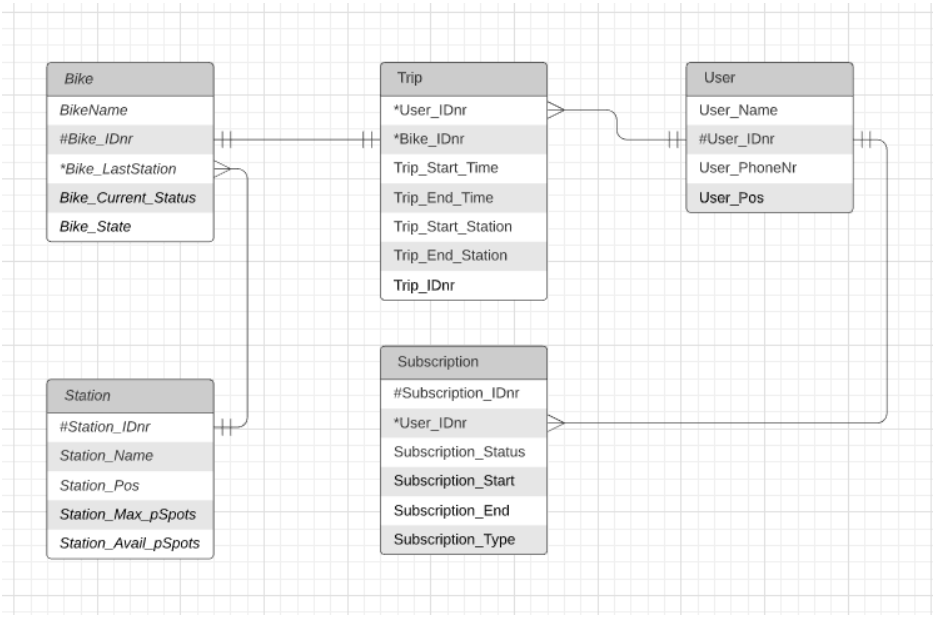
```
SELECT * FROM `trip`
```

User_IDnr	Bike_IDnr	Trip_Start_Time	Trip_End_Time	Trip_Start_Station	Trip_End_Station	Trip_IDnr

The attributes are identified as shown above, and the code if necessary is shown below.

```
CREATE TABLE Trip ( User_IDnr VARCHAR (10), Bike_IDnr VARCHAR (10), Trip_Start_Time TIMESTAMP, Trip_End_Time TIMESTAMP, Trip_Start_Station VARCHAR (10), Trip_End_Station VARCHAR (10), Trip_IDnr VARCHAR (10) )
```

1.2 Extend your ER diagram with this new entity and represent the relations between the entities that you identified in the previous question. Specify the primary keys and choose appropriate relationships between the entities.



1.3 The current database design is taking too much storage (some of your tables contains redundant information). Luckily you learned in INF115 lectures that there are 4 normalization forms to reduce size of a database system. First, explain the four normalization forms(1NF, 2NF, 3NF, BCNF).

Solution:

1NF: The first normal form says that an attribute's domain must only have atomic values, and that it has to be a single value. A relation in 1NF contains only atomic values and each row produces a unique combination of values. Therefore, a row must now have a column that stores more than one value, data is instead separated into multiple rows.

2NF: If a relation is already in 1NF and each attribute *fully* depends on the PK of the relation, it is in 2NF. 2NF is based on full functional dependency meaning the dependency A -> B is a full functional dependency if the dependency doesn't hold upon removing an attribute from the dependency.

3NF: If a relation is already in 2NF and the dependency within that relation is not transitive, it is considered to be in 3NF. Transitive means if B depends on A and C depends on B then C depends on A can be assumed.

BCNF: BCNF extends on 3NF by now enforcing that the 3NF table does not have multiple overlapping candidate keys. Then it is in BCNF.

1.4 Your boss wants you to implement the highest normalization form BCNF. Describe what changes you would have made to the current design to achieve this and reduce redundancy. Then create tables to your suggestion.(You don't need to extend your ER-diagram) Mark primary keys and foreign keys. Explain the changes you make. Example: Is Reparation Status atomic (1NF)?

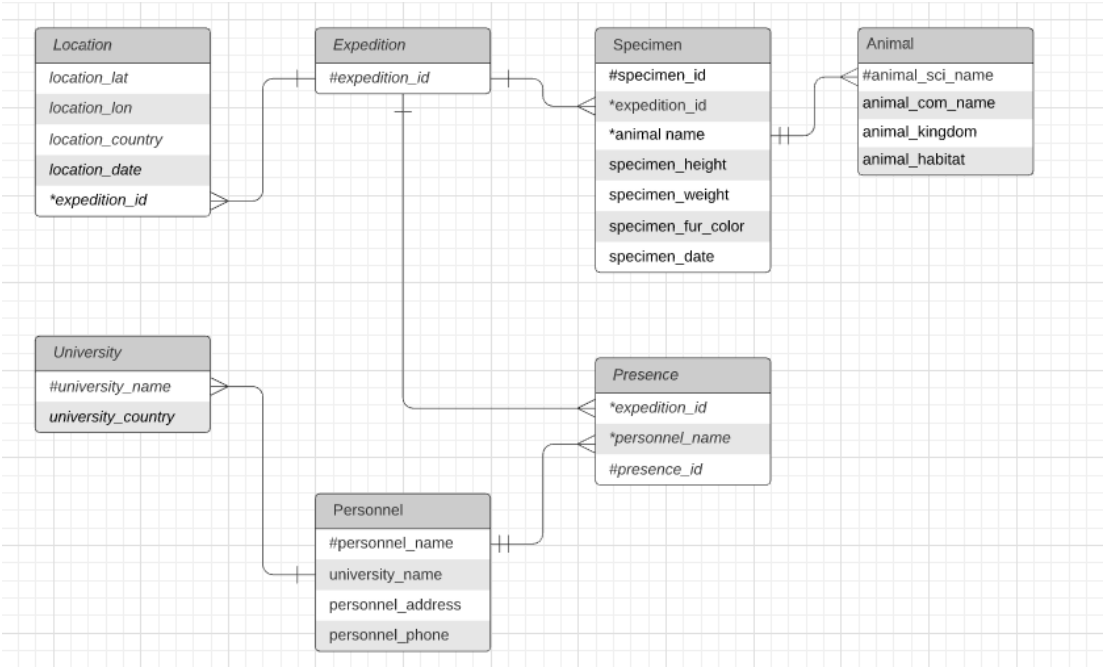
Solution:

Unsure.

Problem 4. (20%)

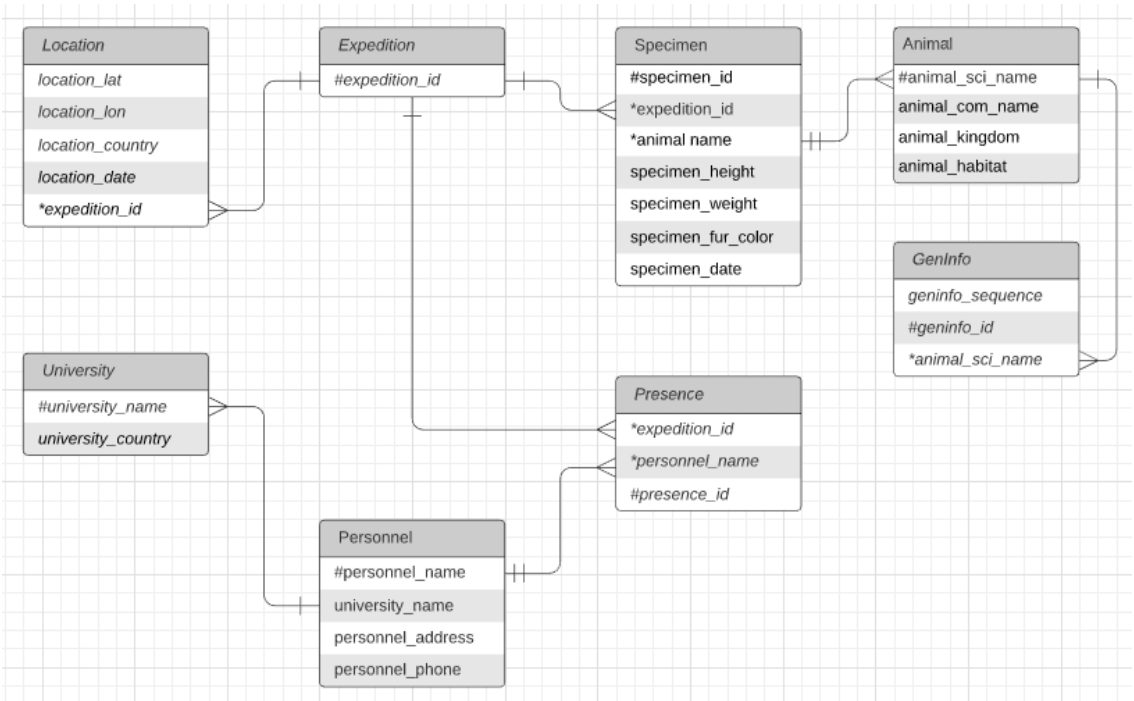
Subproblem 1

Solution:



Subproblem 2

Solution:



Problem 5. (25%)

Subproblem 1

Solution:

First, the Patient table's highest normalization level is 3NF.

Second, the Sample table's highest normalization level is 2NF.

Third, the Labtest table's highest normalization level is 1NF.

Fourth, the Hospital table's highest normalization level is 2NF.

Fifth, the PatientLocation table's highest normalization level is 1NF.

Subproblem 2

Solution: