# Homework 3 Relational databases and normalisation

# 1. A boat hire company stores details of its customers, boats and rentals in a database. The relations in the database hold the following data:

# Boat (BoatName, type, length, berths)

# Customer (CustomerID, Surname, Firstname, AddressLine1, AddressLine2, Town, Postcode, DateOfBirth, email)

# BoatHire (CustomerID, BoatName, HireDate, HireEndDate)

# (a) The key in the BoatHire relation consists of three attributes.

# What is the name given to a key made up of more than one attribute? [1]

# Composite key

# (b) The relations in this database are in Third Normal Form.

# State the properties of a relation in Third Normal Form. [3]

Already in 2nd normal form

* Therefore already in 1st form

No transitive / non key dependencies

[A relation in 3NF depends on the key, the whole key and nothing but the key]

(c) State, with reasons, why it is important that relations in a database are in   
Third Normal Form. [6]

First, it allows better maintenance of the database since no unnecessary data duplication occurs. For example a customer’s data and details will only be stored once if they make multiple requests, like a customer buys multiple products, the database might have a table with multiple records of the customer, since they buy multiple things, but each record might be repeating the persons name a lot of times, so if you have another table that stores the customers details with their id, so the id only has to be referenced in the first table, if you ever need to change a detail of the customer, it will change it for all the records in the first table without having to change every single record of the product they buy.

Another reason is that it makes searching and sorting faster. In third normal form, there are multiple, smaller sized tables. This makes sorting and searching a lot faster since database is broken up into smaller tables so less data involved per tables.

One more reason is to prevent accidental deletion of one side of a one to many relationship. For example a customer who hasn’t paid an invoice cannot be accidentally deleted so that they don’t have to pay it anymore.

(d) Complete the Entity-Relationship diagram below to show the degree of the relationships between the entities. [3]



Boat

Customer

BoatHire

2. A database is to be created to hold data about students at a Sixth Form College and the subjects they study.

Students study a number of subjects, and each subject has one subject leader.

The table below is a first attempt at the design of the database.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| StudentID | Name | TutorGroup | Tutor | Subject | Level | SubjectLeader |
| S1000 | Bella | 2 | CKE | History  Geography  Economics | A  A  AS | AJH  BJG  CKE |
| S2000 | Jane | 3 | KPR | English  French  Russian | AS  A  A | DRE  FJF  KPR |
| S3000 | Greg | 1 | DRE | English  Geography | A  A | DRE  BJG |

(a) Explain, with reference to the data, why the table is not in First Normal Form (1NF). [2]

The data is not atomic, as seen in the attributes subject, level, and subjectleader. They all have 3 pieces of data in them.

(b) The design is changed to:

Student (StudentID, Name, TutorGroup, Tutor)

StudentSubject (StudentID, Subject, Level, SubjectLeader)

Show how the data given in the table above would be held in these two tables. [3]

Table: **Student**

|  |  |  |  |
| --- | --- | --- | --- |
| StudentID | Name | TutorGroup | Tutor |
| S1000 | Bella | 2 | CKE |
| S2000 | Jane | 3 | KPR |
| S3000 | Greg | 1 | DRE |

Table: **StudentSubject**

|  |  |  |  |
| --- | --- | --- | --- |
| StudentID | Subject | Level | SubjectLeader |
| S1000 | History | A | AJH |
| S1000 | Geography | A | BJG |
| S1000 | Economics | AS | CKE |
| S2000 | English | AS | DRE |
| S2000 | French | A | FJF |
| S2000 | Russian | A | KPR |
| S3000 | English | A | DRE |
| S3000 | Geography | A | BJG |

(c) A student is not allowed to study the same subject at A and AS Level. [1]

What is the primary key of the table StudentSubject?

StudentID + Subject, a composite primary key

(d) The two tables Student and StudentSubject are related. Explain how this is achieved using a primary and a foreign key. [2]

StudentID is a key that appears in both tables, making it a foreign key. In StudentSubject, the primary key is a composite key consisting of both StudentID and Subject, while StudentID is the primary key in Student table. Since a foreign key is used in the primary key in second table, the two tables are linked because the attributes from Student is usable in the second table.

(e) Explain why the table StudentSubject is not in Second Normal Form (2NF). [2]

There are still partial dependencies, for example, SubjectLeader depends on Subject, but it doesn’t depend on StudentID therefore partially dependent. A second normal form table must be already in 1st normal form which this one is, but also have no partial dependencies.

(f) Explain why the table Student is not in Third Normal Form (3NF) [2]

To be in 3rd normal form, it has to be both already in 2nd normal form, and have no transitive / non key dependencies. The table is indeed already in 2nd normal form because there are no partial dependencies since all the attributes are dependent on the primary key only. However, there are transitive dependencies. Although Tutor attribute is dependent on primary key StudentID, it is dependent on it indirectly. Tutor depends on TutorGroup, so whatever TutorGroup is, it will change depending on that, but TutorGroup is dependent on StudentID, different students will be in different TutorGroups. Therefore Tutor is indirectly dependent on StudentID, and this is transitive since it depends on StudentID via another key.

[Total 25 Marks]