

Name

UIN

Homework Assignment 3

April 4th, 2026

Due on April 20th, 11:59pm (midnight)

CS480 - Database Systems

Please leave this empty!

3.1

3.2

3.3

Sum

Instructions

- Try to answer all the questions using what you have learned in class
- Some questions are marked as bonus. You do not have to answer these questions to get full points for the assignment. However, you can get bonus points for these questions!

Part 3.1 Modelling (Total: 60 Points)

Question 3.1.1 (60 Points)

Build a conceptional model for a **online car rental system**. The solution should be presented as an **ER-diagram**. Your design should implement the following requirements.

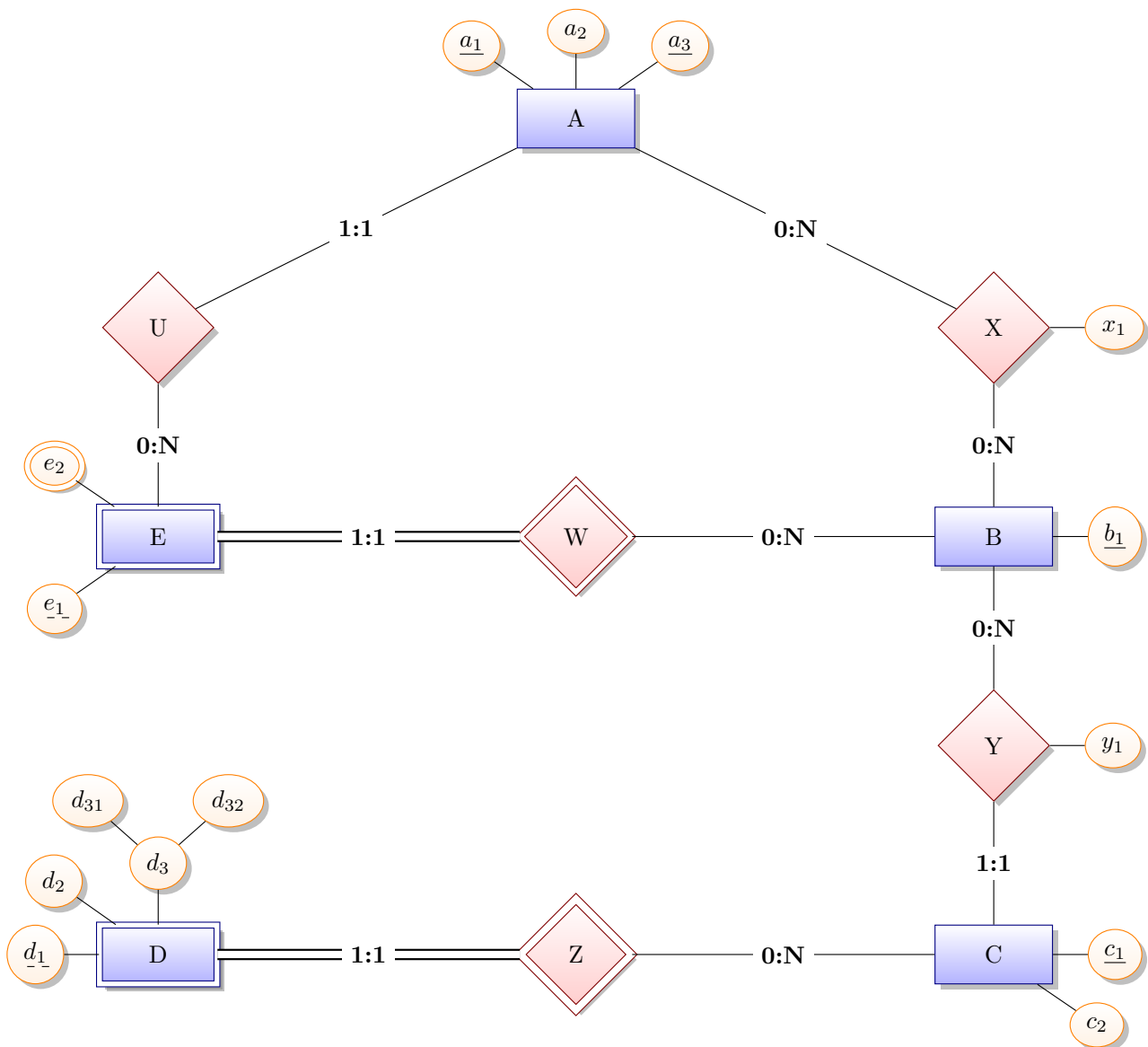
- The database should record information about **Rental Agencies**, **Vehicles**, and **Clients**.
- A **Rental Agency** is identified by its unique *corporate name*. For each rental agency we also record the *year* it was founded. Furthermore, each rental agency can have one or more **Offices**. For each office we record the *location* (a composite attribute consisting of a *street*, *streetnumber*, *city*, *state*, and *zip*) and its *operation capacity* (total number of parking spots). Within a single agency, an office is uniquely identified by its *location*.
- Each **Vehicle** is stationed at exactly one office. Vehicles are described by their *VIN* (Vehicle Identification Number), *vehicle type* (which includes *make*, *model*, and *year*), and *daily rental rate*. A vehicle is uniquely identified by its *VIN*.
- **Clients** are uniquely identified by their *Drivers License Number*. We store the client's *full name* (which includes a *last name* and one or more *given names*) and a *contact number*. Furthermore, we record one or more **Payment Methods** for each client. A payment method is uniquely identified by its *card number* for a given client, and we also record its *billing zip code*.
- A **Booking** is uniquely identified by a *booking number*. Each booking is made by exactly one *client* for a specific *vehicle*. Furthermore, each booking is paid for using exactly one of the client's **Payment Methods** (a payment method can be used for multiple bookings). For each booking we also record the *start date*, *end date*, and the *total cost* of the reservation.

Part 3.2 Translation of ER into Relational Model (Total: 40 Points)

Question 3.2.1 (40 Points)

Take the following ER-model and translate it into a relational schema using the rules presented in class. Present the relational schema as an SQL script (assume that all attributes are of data type INT). Present the results of the following intermediate steps in this order:

1. Translate strong entities + unnest composite attributes
2. Translate weak entities
3. Translated multi-valued attributes
4. Translate relationships



Part 3.3 Normalization (Total: 10 (BONUS) Points)

Question 3.3.1 (10 (BONUS) Points)

Consider the following relations and for each determine in which normal form the relation is (note that a relation can be in multiple normal forms). Please consider the following normal forms: 1NF, 2NF, 3NF and BCNF.

1. $R(A, B, C, D, E, F)$ and the functional dependencies are $AB \rightarrow CF$, $B \rightarrow D$, $D \rightarrow E$, $B \rightarrow C$
2. $R(A, B, C, D, E, F)$ and the functional dependencies are $ABC \rightarrow D$, $D \rightarrow EF$, $D \rightarrow E$, $E \rightarrow F$
3. $R(A, B, C, D, E, F)$ and the functional dependencies are $AB \rightarrow CD$, $C \rightarrow DE$, $DE \rightarrow AB$, $D \rightarrow B$, $DEF \rightarrow C$
4. $R(A, B, C, D, E, F)$ and the functional dependencies are $A \rightarrow B$, $B \rightarrow C$, $C \rightarrow D$, $D \rightarrow E$, $E \rightarrow F$, $F \rightarrow A$, $AC \rightarrow B$

