Databases I. Normalization **Exercises for 13.03.2019**

1. For each of the following, find a minimal key and decompose as necessary to reach the 3NF. Show decomposed relations with keys.

    1. R(A, B, C, D, E, F) and A -> BCDEF

    2. R(A,B,C,D) and AB -> CD, C -> D

    3. R(A,B,C,D) and AB -> D, B -> C

    4. R(A,B,C,D,E) and ABC -> D, D -> E

2. Consider the following relation:

    CAR_SALE(Car#, Date_sold, Salesperson#, Commission%, Discount_amt)

    Assume that a car may be sold by multiple salespeople, and hence {Car#, Salesperson#} is the primary key. Additional dependencies are

    Date_sold → Discount_amt and

    Salesperson# → Commission%

    Based on the given primary key, is this relation in 1NF, 2NF, or 3NF? Why or why not? How would you successively normalize it completely?

3. Create a normalized Data model according to the following text:
    a. A company has a set of departments.
    b. Each department has a set of employees, a set of projects, and a set of offices.
    c. Each employee has a job history (set of jobs the employee has held). For each such job, the employee also has a salary history (set of salaries received while employed on that job)
    d. Each office has a set of phones.

    The database is contain the following information.

    - For each department: department number (unique), budget, and the department manager's employee number (unique)
    - For each employee: employee number (unique), current project number, office number, phone number; also title of each job the employee has held, plus date and salary for each distinct salary received in that job.
    - For each project: project number (unique) and budget.
    - For each office: office number(unique), area in square feet, and numbers (unique) of all phones in that office.

4. A database used in an order-entry system is to contain information about customers, items, and orders. The following information is to be included.

- For each customer:
  - Customer number (unique)
  - "Ship-to" addresses (several per customers)
  - Balance
  - Credit limit
  - Discount
- For each order:
  - Heading information: customer number
  - ship-to address
  - date of order
  - Detail lines(several per order): item number
  - quantity ordered
- For each item:
  - Item number (unique)
  - Manufacturing plants
  - Quantity on hand at each plant
  - Stock danger level for each plant
  - Item description

Design a normalized database for this data.

5. Assume we have the following application that models soccer teams, the games they play, and the players in each team. In the design, we want to capture the following:

• We have a set of teams, each team has an ID (unique identifier), name, main stadium, and to which city this team belongs.

• Each team has many players, and each player belongs to one team. Each player has a number (unique identifier), name, DoB, start year, and shirt number that he uses.

• Teams play matches, in each match there is a host team and a guest team. The match takes place in the stadium of the host team.

• For each match we need to keep track of the following:

o The date on which the game is played

o The final result of the match

o The players participated in the match. For each player, how many goals he scored, whether or not he took yellow card, and whether or not he took red card.

o During the match, one player may substitute another player. We want to capture this substitution and the time at which it took place.

• Each match has exactly three referees. For each referee we have an ID (unique identifier), name, DoB, years of experience. One referee is the main referee and the other two are assistant referee.

Design an ER diagram to capture the above requirements. State any assumptions you have that affects your design.

6. Map the ERD in Exercise 5 to create the relational model corresponding to the described application. Basically, list the relation schemes with the attribute names. Also make sure to have the primary keys and foreign keys clearly defined.