

**SCHOOL OF COMPUTING,**

**FACULTY OF ENGINEERING**

**SCSD 2523 (DATABASE)**

Activity : Lab Activity 11: Normalization

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**PROBLEM 1**

Table 2.1 STUDENTFINE records data on traffic offences by students in a college.

**TABLE 2.1 STUDENTFINE**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **StudentID** | **Name** | **LicenseNo** | **CarReg** | **ReceiptNo** | **Date** | **OffenceCode** | **Fine(RM)** |
| F1011 | CK Fong | P100 | JGK9201 | 00-345 | 10/03/06 | 2 | 30.00 |
|  |  |  |  | 00-690 | 15/03/06 | 1 | 20.00 |
|  |  |  |  | 00-810 | 20/03/06 | 2 | 30.00 |
| L782 | AdamJames | P290 | JJL99 | 00-459 | 13/03/06 | 1 | 20.00 |
| H762 | MalaDewi | P764 | JJK7654 | 00-564 | 12/03/06 | 3 | 40.00 |
|  |  |  |  | 00-770 | 19/06/06 | 2 | 30.00 |

(a) Table 2.1 is said to be an unnormalized table. Why?

Table 2.1 is unnormalized because it contains repeating groups and multiple values for some attributes within the same row. For example, StudentID F1011 has three different ReceiptNo, Date, OffenceCode, and Fine(RM) values, which violate the rule of atomicity in relational databases.

(b) Transform the unnormalized Table 2.1 into a first normal form (1NF) table. Show the transformed 1NF table. What is the primary key for this new INF table?

**1NF Table**: Each cell contains a single value, and there are no repeating groups.

| **StudentID** | **Name** | **LicenseNo** | **CarReg** | **ReceiptNo** | **Date** | **OffenceCode** | **Fine(RM)** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| F1011 | CK Fong | P100 | JGK9201 | 00-345 | 10/03/06 | 2 | 30.00 |
| F1011 | CK Fong | P100 | JGK9201 | 00-690 | 15/03/06 | 1 | 20.00 |
| F1011 | CK Fong | P100 | JGK9201 | 00-810 | 20/03/06 | 2 | 30.00 |
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**Primary Key**: Composite key (StudentID, ReceiptNo).

(c) Based on your answer in (b), lists all functional dependencies for the new INF relation.

#### (c) Functional Dependencies

1. StudentID → Name, LicenseNo, CarReg
2. ReceiptNo → Date, OffenceCode, Fine(RM)
3. (StudentID, ReceiptNo) → All attributes in the table

(d) From your answers in (b) and (c), produce relation(s) that is/are in second normal form (2NF). For each 2NF relation produced, underline the primary key.

#### (d) Convert to 2NF

**Decompose into two relations to remove partial dependency**:

1. **STUDENT**
   * Attributes: StudentID (PK), Name, LicenseNo, CarReg
2. **FINE**
   * Attributes: ReceiptNo (PK), StudentID (FK), Date, OffenceCode, Fine(RM)

(e) Are all 2NF relations produced in Question 2(d) are in third normal form (3NF)? Produce a final set of relations that satisfy the rule of 3NF.

#### (e) Convert to 3NF

**Remove transitive dependency**:

1. **STUDENT**
   * Same as above.
2. **OFFENCE**
   * Attributes: OffenceCode (PK), Description
3. **FINE**
   * Attributes: ReceiptNo (PK), StudentID (FK), Date, OffenceCode (FK), Fine(RM)

**PROBLEM 2:**

Consider the EQUIPMENT\_REPAIR relation in Table B-1, which stores data about office equipment and equipment repairs.

#### EQUIPMENT\_REPAIR

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **EquipmentID** | **Equipment**  **Type** | **PurchasePrice (RM)** | **RepairNumber** | **RepairDate** | **RepairCharge**  **(RM)** |
| 100A | Photocopier | 10,000 | 2000 | 5/11/07 | 500 |
| 200E | Paper shredder | 3,000 | 2100 | 7/1107 | 75 |
| 100B | Photocopier | 5,000 | 2200 | 19/11/07 | 126 |
| 300F | Fax machine | 1,500 | 2300 | 11/11/07 | 38 |
| 100A | Photocopier | 10,000 | 2400 | 9/12/07 | 340 |
| 100B | Photocopier | 5,000 | 2500 | 15/12/07 | 120 |

## Table B-1

1. Identify the type of anomaly for each following cases and explain the problem that will occur to the EQUIPMENT\_REPAIR relation.
2. A staff removes the second row from Table B-1.

#### (a) Anomalies in Table B-1

1. **Deletion Anomaly**:
   * Removing row 2 (200E) will lose information about the paper shredder completely.
2. **Insertion Anomaly**:
   * Cannot record a new repair without including the EquipmentID and PurchasePrice.

#### (b) Normalize Table B-1 to 3NF

1. **1NF**: Eliminate repeating groups.
2. **2NF**: Decompose to remove partial dependency:
   * **EQUIPMENT**: EquipmentID (PK), Equipment, Type, PurchasePrice
   * **REPAIR**: RepairNumber (PK), EquipmentID (FK), RepairDate, RepairCharge
3. A staff enters new details on repairs to the photocopier which was made on 29/12/07 and 19/1/08.

**PROBLEM 3**

2. Consider the following **KIDS\_INDOOR\_ACTIVITY** relation in Table B-2:

### Table B-2 KIDS\_INDOOR\_ACTIVITY

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **KidsID** | **Name** | **Age** | **Indoor**  **Activity** | **Time** | **Room No** | **Location** | **Day** | **Activity**  **Attendant** |
| 0019 | Iman | 9 | Drawing | 2.00-  4.00 | BK7 | Indah  Wing | Saturday | Fahmi |
| 0019 | Iman | 9 | Painting | 2.30-  4.30 | BK5 | Damai Wing | Sunday | Lim |
| 0034 | Aisyah | 9 | Painting | 2.30-  4.30 | BK5 | Damai Wing | Sunday | Lim |
| 0046 | May | 10 | Clay  Handicraft | 3.30-  4.30 | BK1 | Seri Wing | Saturday | Yong |
| 0046 | May | 10 | Origami | 3.00-  5.00 | BK6 | Permai Wing | Sunday | Ema |
| 0061 | Iffah | 8 | Clay  Handicraft | 3.30-  4.00 | BK1 | Seri  Wing | Saturday | Yong |
| 0061 | Iffah | 8 | Painting | 2.30-  4.30 | BK5 | Damai  Wing | Sunday | Lim |

Assuming a kid can join only one indoor activity in a day and each indoor activity is held in a fixed room and location.

1. Identify and list all functional dependencies in Table B-2.

#### (a) Functional Dependencies in Table B-2

1. KidsID → Name, Age
2. (Indoor Activity, Day) → Room No, Location, Activity Attendant
3. (KidsID, Day) → Indoor Activity
4. Based on your answer in Question 2(a) above, normalized the KIDS\_INDOOR\_ACTIVITY relation in Table B-2 into relation(s) in the highest normal form (i.e. 3 NF). Show steps and relations produce in each normal form (1 NF, 2NF and 3NF).

#### (b) Normalize Table B-2 to 3NF

1. **1NF**: Eliminate repeating groups.
2. **2NF**:
   * **KIDS**: KidsID (PK), Name, Age
   * **ACTIVITY\_SCHEDULE**: Indoor Activity, Day (PK), Room No, Location, Activity Attendant
   * **PARTICIPATION**: KidsID, Day (PK), Indoor Activity
3. **3NF**: Already in 3NF as there are no transitive dependencies.

**PROBLEM 4**

The table shown in Figure 13.19 lists dentist/patient appointment data. A patient is given an appointment at a specific time and date with a dentist located at a particular surgery. On each day of patient appointments, a dentist is allocated to a specific surgery for that day.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **staffNo** | **dentistName** | **patNo** | **patName** | **appointment**  **date time** | **surgeryNo** |
| S1011 | Tony Smith | P100 | Gillian White | 12/09/04 10.00 | S15 |
| S1011 | Tony Smith | P105 | Jill Bell | 12/09/04 12.00 | S15 |
| S1024 | Helen Pearson | P108 | Ian MacKay | 12/09/04 10.00 | S10 |
| S1024 | Helen Pearson | P108 | Ian MacKay | 14/09/04 14.00 | S10 |
| S1032 | Robin Plevin | P105 | Jill Bell | 14/09/04 16.30 | S15 |
| S1032 | Robin Plevin | P110 | John Walker | 15/09/04 18.00 | S13 |

**Figure 13.19**

1. The table shown in Figure 13.19 is susceptible to update anomalies. Provide examples of insertion, deletion, and update anomalies.

#### (a) Anomalies in Figure 13.19

1. **Insertion Anomaly**:
   * Cannot add a new dentist without assigning an appointment.
2. **Deletion Anomaly**:
   * Removing an appointment may lose details of a dentist or patient.
3. **Update Anomaly**:
   * Updating surgery number requires changes in multiple rows.
4. Describe and illustrate the process of normalizing the table shown in Figure 13.19 to 3NF. State any assumptions you make about the data shown in this table.

#### (b) Normalize Figure 13.19 to 3NF

1. **1NF**: Eliminate repeating groups.
2. **2NF**:
   * **DENTIST**: staffNo (PK), dentistName
   * **PATIENT**: patNo (PK), patName
   * **APPOINTMENT**: staffNo, patNo, appointment (PK), date, time, surgeryNo
3. **3NF**:
   * Add a SURGERY table: surgeryNo (PK), SurgeryDetails