BUS-ADM 749 Data and Information Management

Assignment 2 – Venkata Gayathri Peri

1. Translate the conceptual schema for Continental Palms Hardware Company (CPHC) into a logical schema. Make sure all tables are in 3NF. Specify all the integrity constraints.

    1. Weak entity – 1 table
    ClientEmployee (ClientNo,ID, firstName, lastName)
    Primary Key {ClientNo, ID}
    Foreign Key {ClientNo} References Client {ClientNo}

    2. Sub class – 1 table
    Salesperson (ID, cellphone, commission, manager)
    Primary Key {ID}
    Alternative Key {cellPhone}
    Foreign Key {ID} References Employee {ID}
    Foreign Key {manager} References Salesperson {ID}

Constraint: “The supervision relationship between salespersons is hierarchical up to three levels.”

Constraint: “The commission percentage of a salesperson is in the range of 0 to 25.”

Strong entities – 6 tables

3. Employee (ID, firstName, lastName, title, gender, homePhone, workPhone, birthdate, hireDate, officeNo)
Primary Key {ID}
Foreign Key {officeNo} References Office {officeNo}
Constraint: “The gender of an employee can be male or female.”
Constraint: “The age of an employee at the hire date must be at least 18 years.”

4. Office (officeNo,fax,officeSize,capacity)
Primary Key {officeNo}
Constraint: “The capacity of an office is between one and five.”
Constraint: “The number of employees working in an office cannot exceed the capacity of the office.”

5. Payment(paymentNo,paymentDate,method,amount,ID)
Primary Key {paymentNo}
Foreign Key {ID} References Employee {ID}
Foreign Key {ID} References ClientEmployee{ID}

6. Product (UPC,name,manufacturer,unitPrice)
Primary Key {UPC}
Constraint: “The composition relationship between products and parts is hierarchical up to five levels.”

Constraint: “The quantity of a part that is included in a larger product must be at least one.”

7. Sale(invoiceNo,invoiceDate,total,salespersonID,cellPhone,UPC,)
   Primary Key{invoiceNo}
   Alternate Key{cellPhone}
   Foreign Key {salespersonID} References SalesPerson{salespersonID}
   Foreign Key {UPC} References Product {UPC}

8. Client (clientNo,name,street,city,state,zip, salespersonID,)
   Primary Key {clientNo}
   Foreign Key {salespersonID} References SalesPerson{ID}

Multi Valued Attributes – 2 tables

9. ClientPhone(clientNo,phone)
   Primary Key {clientNo,phone }
   Foreign Key {clientNo } References Client{clientNo }
   Constraint: "Client can have upto 3 numbers”

10. ClientEmployeePhone(ID,phone)
    Primary Key {ID}
    Foreign Key {ID} References ClientEmployee{ID }
    Constraint:” Client employee can have upto 3 numbers”

Many to Many relations – 4tables

11. Inclusion (invoiceNo, UPC,quantity)
    Primary Key {invoiceNo, UPC}
    Foreign Key {invoiceNo} References Sale {invoiceNo}
    Foreign Key {UPC} References Product {UPC}

12. Contains (wholeProduct, part, quantity)
    Primary Key {wholeProduct, part}
    Foreign Key {wholeProduct} References Product {UPC}
    Foreign Key {part} References Product {UPC}

13. Backup (salesperson, backup)
    Primary Key {salesperson, backup}
    Foreign Key {salesperson} References Salesperson {ID}
    Foreign Key {backup} References Salesperson {ID}

14. Selling(salespersonID,cellPhone,UPC,quantity)
    Primary Key{salespersonID,UPC}

Alternate Key {cellPhone}
Foreign Key{salespersonID} References SalesPerson{salespersonID}
Foreign Key{UPC} References Product{UPC}

DATABASE CONSTRAINTS:

Constraint: “The salesperson selling a sale to a client must be the salesperson assigned to work with the client or a backup or the manager of the salesperson.”
Constraint: " If a salesperson is authorized to sell a product, he must be authorized to sell all the parts included in the product, if any”
Constraint: “The client of a payment must be the same as the client of the sale the payment pays.”
Constraint: " The total amount of the payments for a sale cannot exceed the total amount of the sale.”
Constraint: “The quantity of a product sold in a sale must be at least one.”
Constraint: “Every product sold in a sale must be one that the salesperson is authorized to sell.”

2. Write the following queries in relational algebra and tuple relational calculus.

- Get the first name and last name of every employee of CPHC.

  RA**:** $\Pi_{\text{firstName, lastName,}}$ (Employee)
  TRC: {E.firstName, E.lastName | Employee(E)}

- Get the first name and last name of every female employee of CPHC.

  RA:$\Pi_{\text{firstName, lastName,}}$ (σ gender= “Female” (Employee))
  TRC: {E.firstName, E.lastName | ∃ E Employee(E) ∧ E.gender= “Female”}

- Get the first name and last name of every female salesperson.

  RA: $\Pi_{\text{firstName, lastName,}}$ (σ gender= “Female” ((Employee ⋈ Salesperson)))
  TRC: { e.firstName, e.lastName | ∃ e, s (Employee(e) ∧ Salesperson(s) ∧ e.gender = "Female" ∧ e.EmployeeID = s.EmployeeID) }

- Get the first name and last name of every female salesperson who sells some products manufactured by Stanley.
  RA: Π firstName, lastName ((σ manufacturer= “Stanley” (σ Gender= “female”((Employee ⋈ Salesperson) ⋈ Product))))
  TRC :{ e.firstName, e.lastName> | ∃ e, s, p (Employee(e) ∧ Salesperson(s) ∧ Product(p) ∧ e.gender = "female" ∧ p.manufacturer = "Stanley" ∧ e.ID = s.ID ∧ s.UPC = p.UPC) }

3. CPHC also hired another consulting group to design the database. In their design, there is the following big table:

Sale (invoiceNo, invoiceDate, clientNo, clientName, streetAddress, city, state, zip, salesperson, UPC, productName, manufacturer, unitPrice, quantity)

From the requirements, we have identified the following functional dependencies:

clientNo → clientName, streetAddress, city, state, zip

UPC → productName, manufacturer, unitPrice

invoiceNo → invoiceDate, clientNo, salesperson

invoiceNo, UPC → quantity

Now you need to help them do the following:

- Give examples of data redundancies and data anomalies in their big table.
  Data redundancies
  clientName, streetAddress, city, state, zip are dependent on clientNo. productName, manufacturer, unitPrice are dependent on UPC, where Client information (clientName, streetAddress, city, state, zip) is repeated for each sale with the same clientNo and Product information (productName, manufacturer, unitPrice) is repeated for each sale with the same UPC.

  Data anomalities
  Multiple data entires/rows with the same clientNo but different clientName or address information, or multiple rows with the same UPC but different productName or manufacturer information it would result in update anomalies.

- Determine the primary key of their big table.
  The uniqueness of each row must be taken into account when determining the big table's main key. Given the functional requirements, it would seem that the invoiceNo and UPC combined, which uniquely identify a row, should be a candidate key.
- primary key of the big table, Sale is mostly {invoiceNo, UPC}.

- Determine what normal form their big table is in.

  1NF since the table has all atomic attributes and primary keys
- Rescue their design by normalizing their big table into multiple 3NF tables. Rename some of the attributes when appropriate. Indicate the primary key of each table. Specify all the foreign keys.

  Now, let's normalize the table into 3NF. We'll create multiple tables, each with a specific purpose and its own primary key.

Table 1: Clients (Primary Key: clientNo)

clientNo (PK)
clientName
streetAddress
city
state
zip
Table 2: Products (Primary Key: UPC)

UPC (PK)
productName
manufacturer
unitPrice

Table 3: Sale (Primary Key: invoiceNo, UPC)

invoiceNo (PK)
invoiceDate
clientNo (FK referencing Clients)
salesperson
UPC (PK, FK referencing Products)
quantity