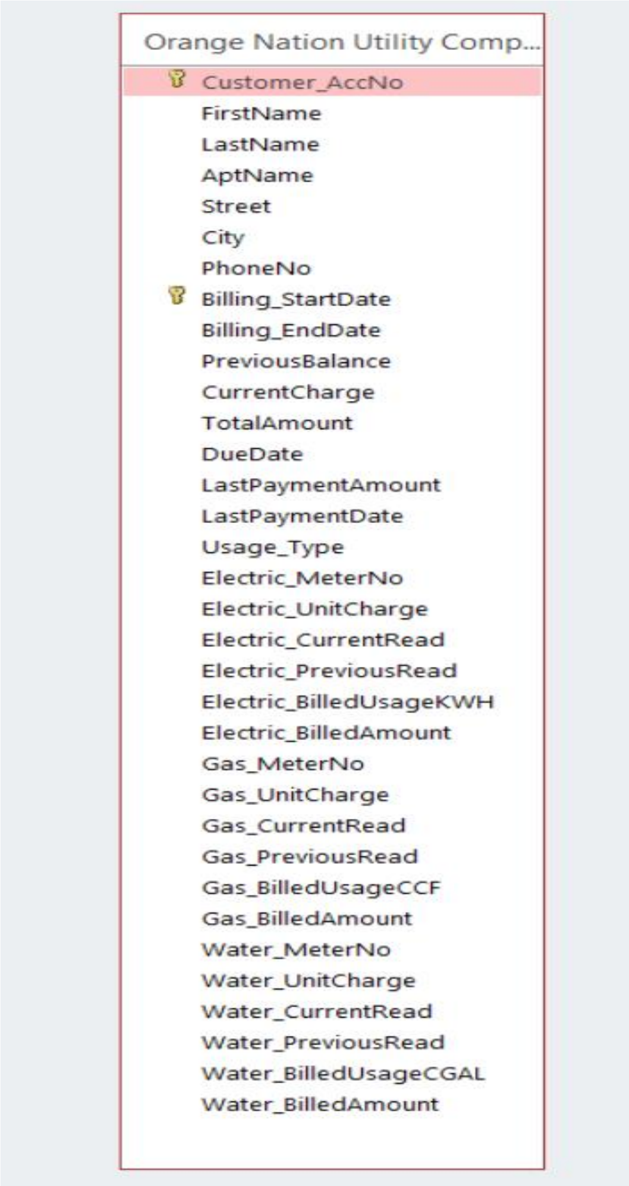
IST 659: Lab-4

Question1: You are hired to develop a normalized data model starting with a sample document (see the table below). The sample document is a utility bill summary sheet that Orange Nation Company is currently using to track the utility usage for its customer accounts. Orange Nation company wants to build a small database to store and retrieve this information.

- Solution:

1. Access table in 1NF form (using Account No and Start Date as a composite PK)



Orange Nation Utility Comp...

🔑 Customer_AccNo
FirstName
LastName
AptName
Street
City
PhoneNo
🔑 Billing_StartDate
Billing_EndDate
PreviousBalance
CurrentCharge
TotalAmount
DueDate
LastPaymentAmount
LastPaymentDate
Usage_Type
Electric_MeterNo
Electric_UnitCharge
Electric_CurrentRead
Electric_PreviousRead
Electric_BilledUsageKWH
Electric_BilledAmount
Gas_MeterNo
Gas_UnitCharge
Gas_CurrentRead
Gas_PreviousRead
Gas_BilledUsageCCF
Gas_BilledAmount
Water_MeterNo
Water_UnitCharge
Water_CurrentRead
Water_PreviousRead
Water_BilledUsageCGAL
Water_BilledAmount

2. Access table in 2NF

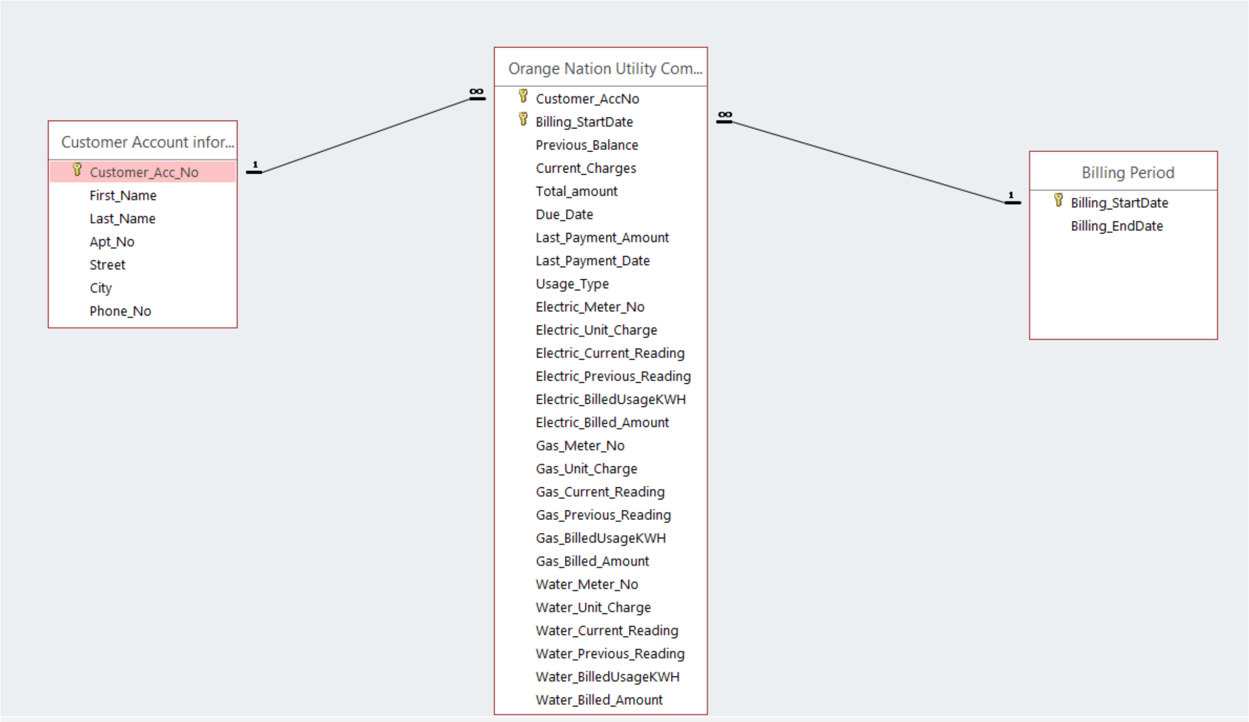
In the above 1NF table, I have found two partial functional dependencies. Since the PK comprises of two attributes hence there will be two functional dependencies, each relating to a part of the PK.

Composite PK : Customer_AccNo , Billing_StartDate

Customer_AccNo → FirstName, LastName, AptName, Street, City, PhoneNo

Billing_StartDate → Billing_EndDate

The partial dependencies can be removed by creating one table for each partial dependency i.e. for 'Customer_AccNo' and 'Billing_StartDate'. Each of the new key will be both PK and FK in the parent table i.e. Orange Nation Utility Company.



Customer Account infor...
Customer_Acc_No
First_Name
Last_Name
Apt_No
Street
City
Phone_No

Orange Nation Utility Com...
Customer_AccNo
Billing_StartDate
Previous_Balance
Current_Charges
Total_amount
Due_Date
Last_Payment_Amount
Last_Payment_Date
Usage_Type
Electric_Meter_No
Electric_Unit_Charge
Electric_Current_Reading
Electric_Previous_Reading
Electric_BilledUsageKWH
Electric_Billed_Amount
Gas_Meter_No
Gas_Unit_Charge
Gas_Current_Reading
Gas_Previous_Reading
Gas_BilledUsageKWH
Gas_Billed_Amount
Water_Meter_No
Water_Unit_Charge
Water_Current_Reading
Water_Previous_Reading
Water_BilledUsageKWH
Water_Billed_Amount

Billing Period
Billing_StartDate
Billing_EndDate

3. Access table in 3NF

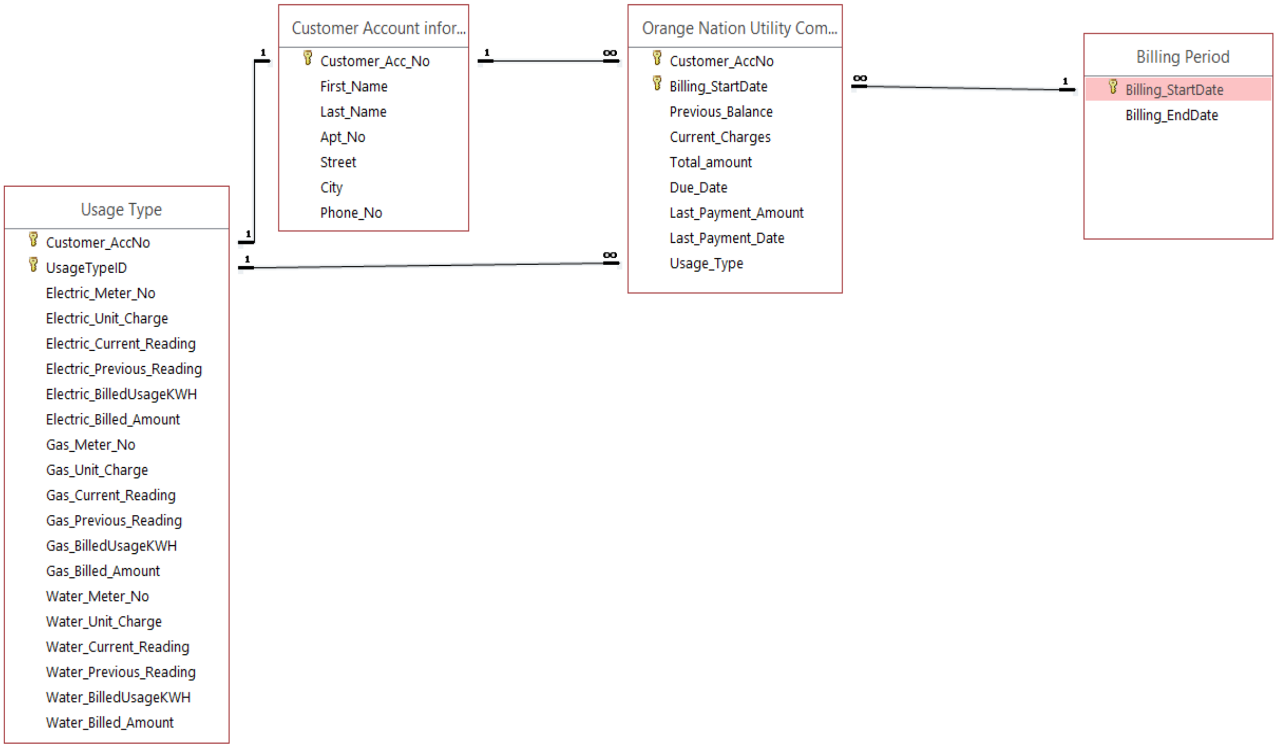
In the above 2NF table, I have found 4 transitive dependencies i.e. Usage_type, Electric_Meter_No, Gas_Meter_No, Water_Meter_No. In the transitive dependency, the non-key attribute determines the non-key attributes in the parent table.

The transitive dependency can be removed by creating one table for each transitive dependency. The ‘Usage_Type’ will become the primary key in the new table and stays as foreign key in the parent table. But in order to uniquely identify the Usage Type table, we can create a composite primary key, where part of the key will be ‘Usage_Type’ from the parent table and part of the key will be ‘Customer_AccNo’ from the ‘Customer Account Information Table’.

3NF can be obtained in 3 steps:

Step-1: Removing transitive dependency-1

Customer_AccNo, Usage_Type → Electric_Meter_No, Electric_Unit_Charge, Electric_Current_Reading, Electric_Previous_Reading, Electric_BilledUsageKWH, Electric_Billed_Amount, Gas_Meter_No, Gas_Unit_Charge, Gas_Current_Reading, Gas_Previous_Reading, Gas_BilledUsageKWH, Gas_Billed_Amount, Water_Meter_No, Water_Unit_Charge, Water_Current_Reading, Water_Previous_Reading, Water_BilledUsageKWH, Water_Billed_Amount.



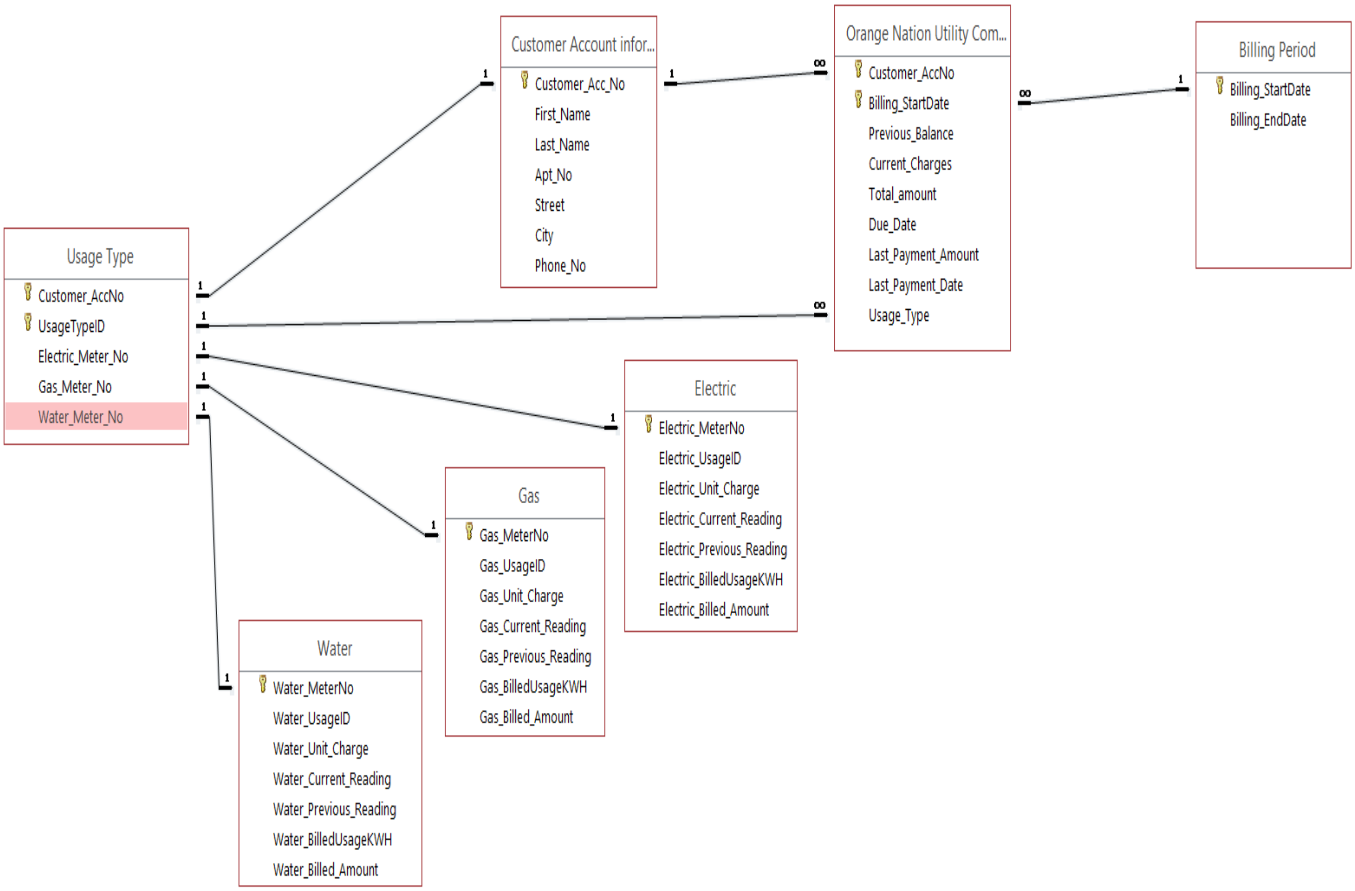
Step-2: Removing transitive dependency-2 by creating separate tables for Electric, Water and Gas usage type.

Customer_AccNo , Usage_Type → Usage_TypeID, Electric_Meter_No, Gas_Meter_No, Water_Meter_No

Electric_Meter_No → Electric_Unit_Charge, Electric_Current_Reading, Electric_Previous_Reading, Electric_BilledUsageKWH, Electric_Billed_Amount.

Gas_Meter_No → Gas_Unit_Charge, Gas_Current_Reading, Gas_Previous_Reading, Gas_BilledUsageKWH, Gas_Billed_Amount.

Water_Meter_No → Water_Unit_Charge, Water_Current_Reading, Water_Previous_Reading, Water_BilledUsageKWH, Water_Billed_Amount.



Step-3: Removing transitive dependency-3 by creating separate tables for Electric, Water and Gas usage type and Meter_No.

Customer_AccNo, Usage_Type → Usage_TypeID, Electric_Meter_No, Gas_Meter_No, Water_Meter_No

Electric_Meter_No → Electric_UsageID

Gas_Meter_No → Gas_UsageID

Water_Meter_No → Water_UsageID

Meter_No → Unit_Charge, Unit_Charge_Type, Current_Reading, Previous_Reading, BilledUsage, Billed_Amount.

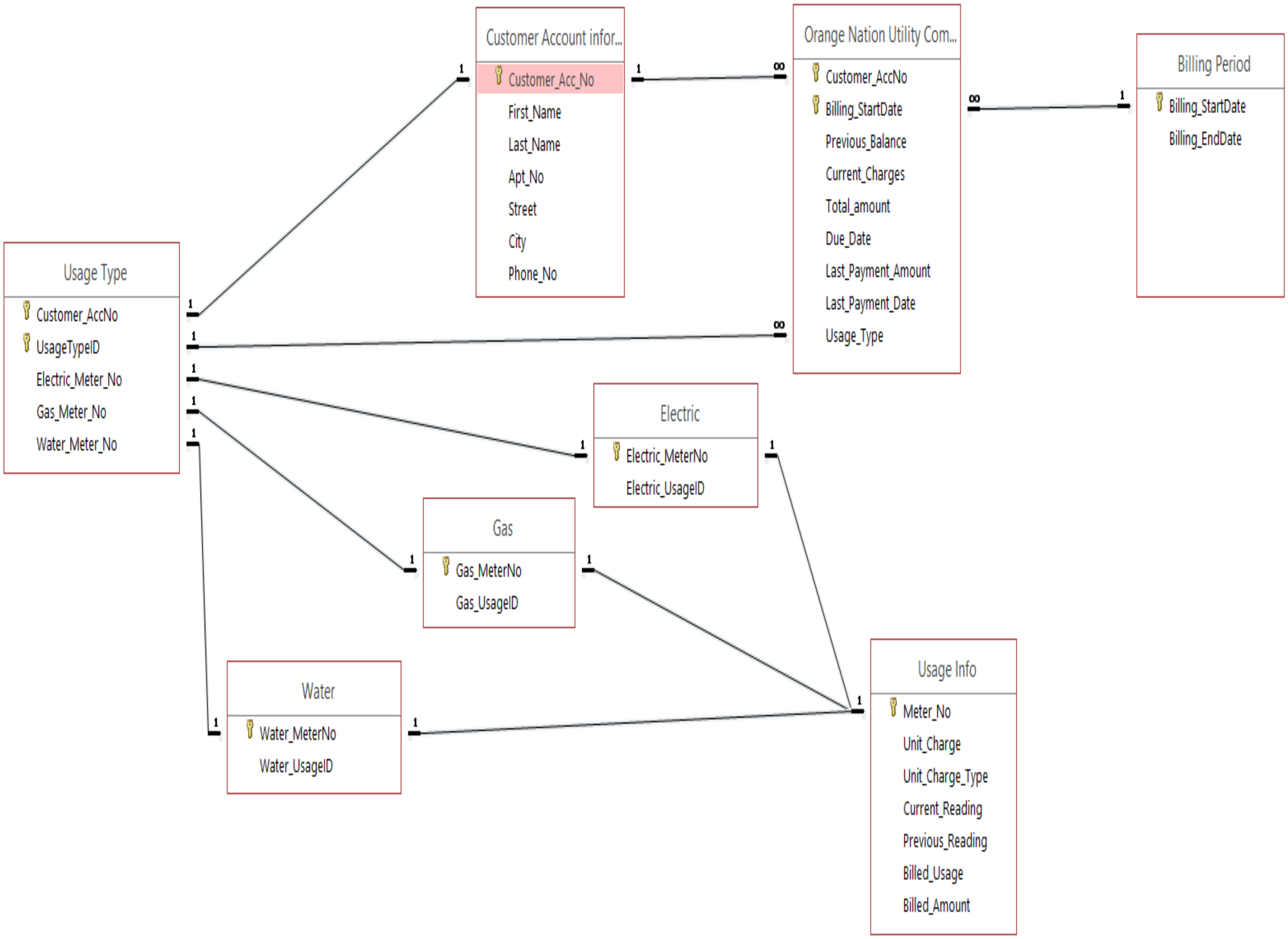


Figure: Data Model conforming to 3NF