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Stage IV: Database Design

The Database Model Document has been updated and is linked on the GitHub homepage.

2) Demonstrate that all the relations in the relational schema are normalized to Boyce–Codd normal form (BCNF).

To start off, our METER relation with candidate keys MeterName and MeterID is already normalized to BCNF because Type is functionally dependent on the primary key (which is a superkey). Next, the COST relation with the primary key MeterName, Year, and Month is already normalized to BCNF because Amount is functionally dependent on the primary key. However, we had to modify the ENERGY relation due to it having multiple or transitive dependencies. We opted to move the Unit attribute to Meter and were able to remove CO_2e, Gals_gas, and Miles_driven all together because they are derived. Now for each relation, all of the functional dependencies (which are listed below) are functionally dependent on a superkey.

Functional Dependencies:
METER:
MeterName -> Type
MeterName -> Type

COST:
MeterName, Year, Month -> Amount

ENERGY:
MeterName, Year, Month -> Amount

3) Define the different views (virtual tables) required. For each view list the data and transaction requirements. Give a few examples of queries, in English, to illustrate.

We will define two views for our project. The first view (METER_COST) will be the result of joining METER and COST on equal MeterName. The second view (METER_ENERGY) will be the result of joining METER and ENERGY on equal MeterName. By defining these views we can access all of the necessary attributes without having to do a join at the start of every query sequence. For example, we can get the type and unit of an energy output without having to do the join at the start.

4) Design a complete set of SQL queries to satisfy the transaction requirements identified in the previous stages, using the relational schema and views defined in tasks 2 and 3 above.

Get cost of a meter for a given year and month:

```
SELECT Amount
FROM METER_COST
WHERE MeterName='(desired_meter)' AND Year='(desired_year)' AND
Month='(desired_month)';
```

Get the average cost of a meter over a given year:

```
SELECT AVG(Amount)
FROM METER_COST
WHERE MeterName='(desired_meter)' AND Year='(desired_year)'
GROUP BY MeterName
ORDER BY AVG(Amount);
```

Get the energy demand of a meter for a given year and month:

```
SELECT Amount
FROM METER_ENERGY
WHERE MeterName='(desired_meter)' AND Year='(desired_year)' AND
Month='(desired_month)';
```

Get the average energy demand of a meter over a given year:

```
SELECT AVG(Amount)
FROM METER_ENERGY
WHERE MeterName='(desired_meter)' AND Year='(desired_year)'
GROUP BY MeterName
ORDER BY AVG(Amount);
```

Get the CO2e/Gallons of Gas/Miles Driven for a meter for a specific year and month:

We will use the query to get the energy demand of a meter for a given year and month. Then, once we get the energy amount and type we can calculate the environmental impact statistics. There is an epa.gov webpage which provides detailed information and examples on how to calculate the statistics we are looking for.

Get the average CO2e/Gallons of Gas/Miles Driven for a meter over a year:

We will use the query to get the energy demand of a meter over a given year. Then, once we get the energy amount and type we can calculate the environmental impact statistics. There is an epa.gov webpage which provides detailed information and examples on how to calculate the statistics we are looking for.

epa.gov webpage:
https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references