ASSIGNMENT-1

Question 1:

ER Diagram Question: Traffic Flow Management System (TFMS)

Scenario

You are tasked with designing an Entity-Relationship (ER) diagram for a Traffic Flow Management System (TFMS) used in a city to optimize traffic routes, manage intersections, and control traffic signals. The TFMS aims to enhance transportation efficiency by utilizing real-time data from sensors and historical traffic patterns.

The city administration has decided to implement a TFMS to address growing traffic congestion issues. The system will integrate real-time data from traffic sensors, cameras, and historical traffic patterns to provide intelligent traffic management solutions. Key functionalities include:

Tasks

Task 1: Entity Identification and Attributes

Identify and list the entities relevant to the TFMS based on the scenario provided (e.g., Roads, Intersections, Traffic Signals, Traffic Data).

Define attributes for each entity, ensuring clarity and completeness.

Task 2: Relationship Modeling

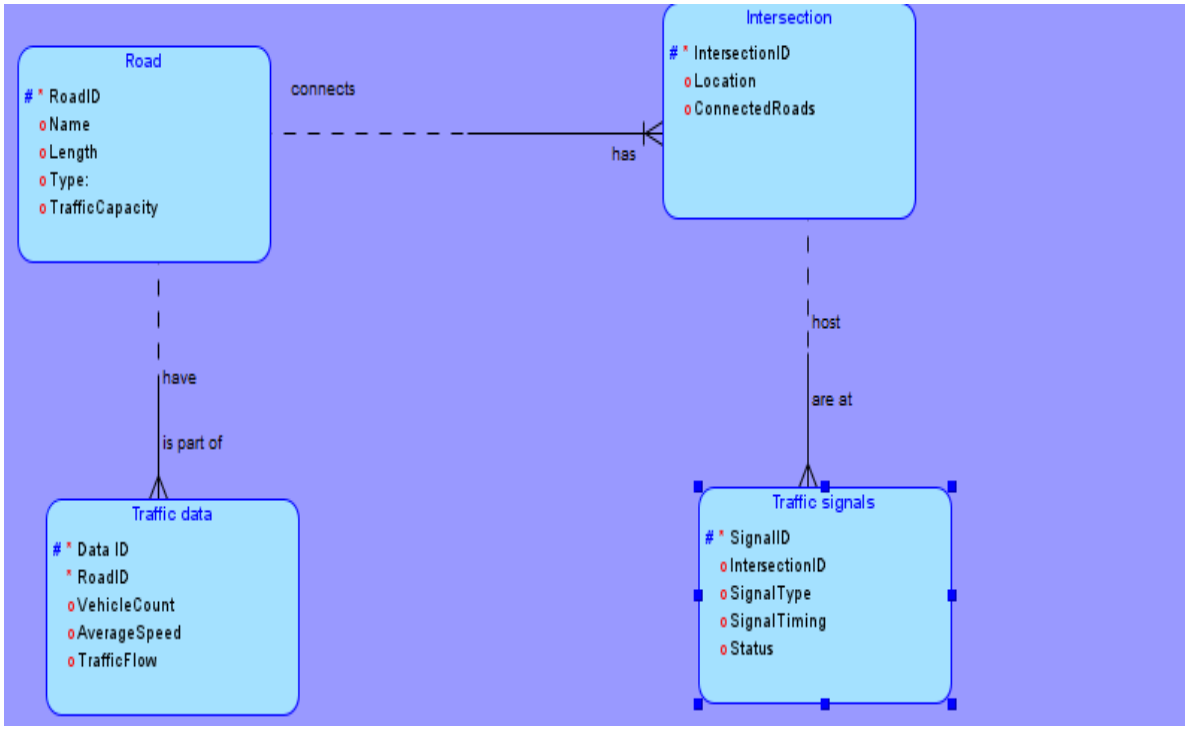
Illustrate the relationships between entities in the ER diagram (e.g., Roads connecting to Intersections, Intersections hosting Traffic Signals).

Specify cardinality (one-to-one, one-to-many, many-to-many) and optionality constraints (mandatory vs. optional relationships).

Task 3: ER Diagram Design

Draw the ER diagram for the TFMS, incorporating all identified entities, attributes, and relationships.

Label primary keys (PK) and foreign keys (FK) where applicable to establish relationships between entities.



Justification :

Design Choices

- **Scalability**: Independent entities enable easy addition of roads, intersections, signals, and traffic data without restructuring.
- **Real-Time Data Processing**: Separate Traffic Data entity allows real-time collection and independent processing for dynamic updates.
- **Efficient Traffic Management**: Logical relationships facilitate efficient data querying and retrieval for traffic management algorithms.

Normalization Considerations

1. **First Normal Form (1NF)**:
    - Each table has a primary key.
    - Each attribute contains atomic (indivisible) values.
    - Each attribute contains values of a single type.
2. **Second Normal Form (2NF)**:
    - The database is in 1NF.
    - All non-key attributes are fully functionally dependent on the primary key.
    - Example: **RoadName**, **Length**, and **SpeedLimit** in the Roads table are dependent only on **RoadID**.
3. **Third Normal Form (3NF)**:
    - The database is in 2NF.
    - There are no transitive dependencies (non-key attributes dependent on other non-key attributes).
    - Example: In the Traffic Signals table, **SignalStatus** and **Timer** depend only on **SignalID**, not on any other non-key attribute.

Entity Definitions:

1) Roads

- **Attributes**:
    - **RoadID** (PK): Unique identifier
    - **RoadName**: Name of the road
    - **Length**: Length in meters
    - **SpeedLimit**: Speed limit in km/h

2)Intersections:

Attributes:

- **IntersectionID** (PK): Unique identifier
- **IntersectionName**: Name of the intersection

3)Traffic Signals:

- **Attributes**:
    - **SignalID** (PK): Unique identifier
    - **SignalStatus**: Current status (Green, Yellow, Red)
    - **Timer**: Countdown to next change
    - **IntersectionID** (FK): Links to intersection

4)Traffic Data:

- **Attributes**:
    - **TrafficDataID** (PK): Unique identifier
    - **Timestamp**: Data collection time
    - **Speed**: Average speed
    - **CongestionLevel**: Traffic congestion degree
    - **RoadID** (FK): Links to road

Relationship Descriptions

1)Roads to Intersections

- **Relationship**: Roads connect to intersections
- **Cardinality**: One-to-Many (One road to multiple intersections)
- **Optionality**: Mandatory for intersections

2)Intersections to Traffic Signals

- **Relationship**: Intersections host traffic signals
- **Cardinality**: One-to-Many (One intersection to multiple signals)
- **Optionality**: Mandatory for signals

3)Roads to Traffic Data

- **Relationship**: Roads have traffic data entries
- **Cardinality**: One-to-Many (One road to multiple data entries)
- **Optionality**: Optional for traffic data