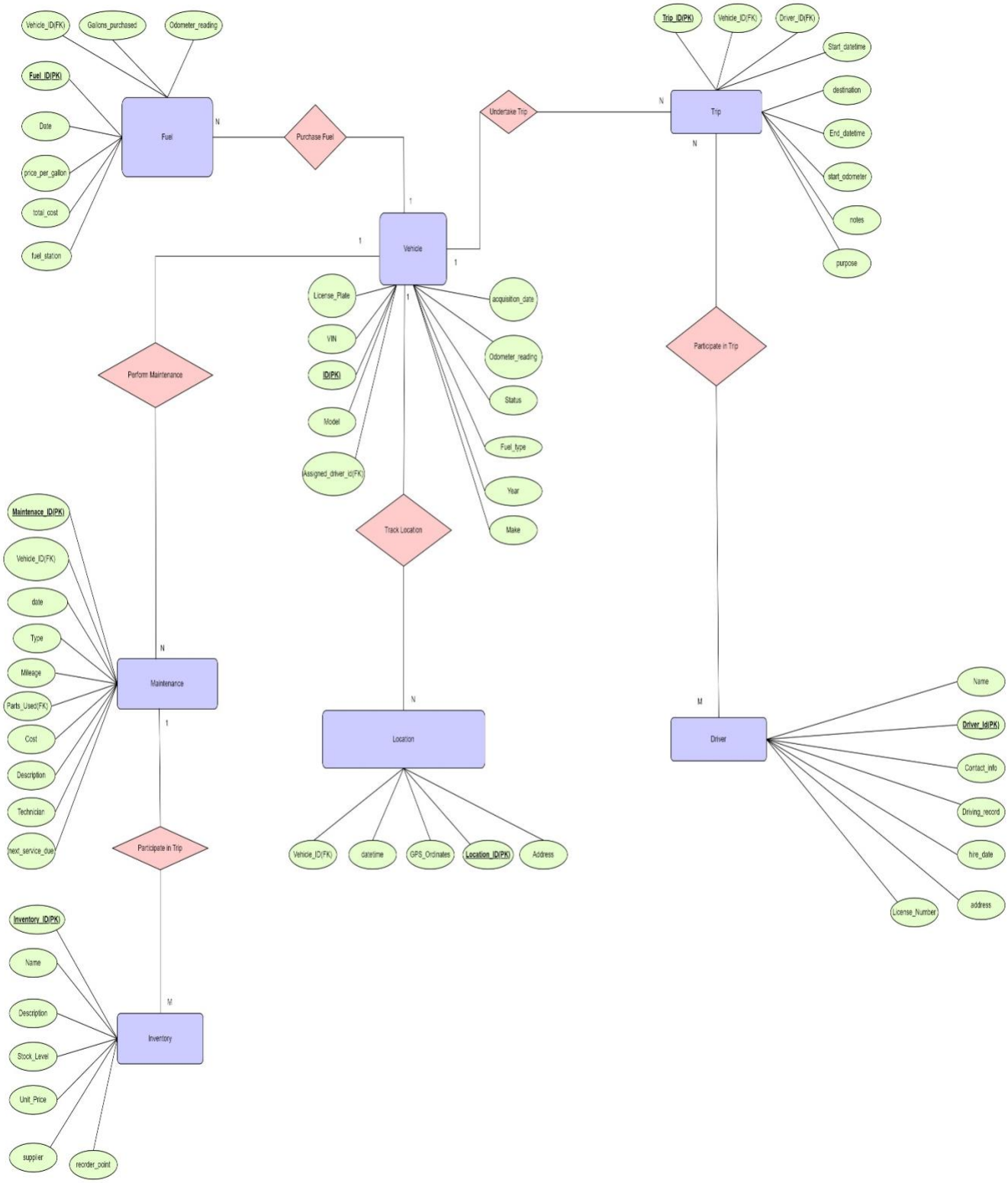
Deliverable 1

(ERD + Relation schema + Business rules)



ER Diagram for FMS Database (Chen Notation)

Relation schema translated from the ERD

Entities:

- **VEHICLE:**
  - Attributes: ID (PK), VIN, model, year, make, license_plate, odometer_reading, fuel_type, acquisition_date, status, assigned_driver_ID (FK)
- **DRIVER:**
  - Attributes: ID (PK), name, license_number, address, contact_info, hire_date, driving_record
- **MAINTENANCE:**
  - Attributes: ID (PK), vehicle_ID (FK), date, type, mileage, cost, description, technician, next_service_due,part_used(FK)
- **FUEL:**
  - Attributes: ID (PK), vehicle_ID (FK), date, gallons_purchased, odometer_reading, price_per_gallon, total_cost, fuel_station
- **TRIP:**
  - Attributes: ID (PK), vehicle_ID (FK), driver_ID (FK), start_datetime, end_datetime, start_odometer, end_odometer, destination, purpose, notes
- **INVENTORY:**
  - Attributes: ID (PK), name, description, stock_level, unit_price, supplier, reorder_point
- **LOCATION (Optional):**
  - Attributes: ID (PK), vehicle_ID (FK), datetime, GPS_coordinates, address

Business rules translated from the ERD

Detailed Business Rules for Fleet Management System

Vehicle:

- Each vehicle must have a unique identifier (VIN or license plate).
- Vehicle model, year, make, and acquisition date are mandatory fields.

- Odometer readings must be nonnegative and increasing over time.
- Fuel type must be valid (e.g., gasoline, diesel, electric).
- A vehicle can be assigned to one driver at a time, but can have multiple drivers throughout its lifetime.
- Maintenance, fuel purchase, and trip data must be associated with the correct vehicle.
- Vehicle status (active, inactive, sold, etc.) should be tracked and reflected in reports.

Driver:

- Each driver must have a unique identifier (license number, employee ID).
- Driver name, contact information, and hire date are mandatory fields.
- Driving record information should be maintained and considered for safety evaluations.
- A driver can participate in multiple trips with different vehicles during different time periods.
- Drivers responsible for creating or completing trips should be clearly identified.

Maintenance:

- Each maintenance record must be associated with a specific vehicle and have a unique identifier.
- Maintenance date, type (preventive, corrective), and cost are mandatory fields.
- Mileage at the time of maintenance should be recorded.
- Technician performing the maintenance and next service due date can be included.
- Parts used during maintenance must be linked to the inventory and their quantities recorded.

Fuel:

- Each fuel purchase record must be associated with a specific vehicle and have a unique identifier.
- Date, gallons purchased, odometer reading, and price per gallon are mandatory fields.
- Total cost and fuel station information can be included.
- Fuel efficiency calculations can be based on fuel purchase and odometer data.

Trip:

- Each trip record must be associated with a specific vehicle and have a unique identifier.

- Start and end date/time, start and end odometer readings, and destination are mandatory fields.
- Driver participating in the trip can be linked.
- Purpose and notes about the trip can be added.
- Trip data can be used for route optimization, mileage tracking, and driver performance analysis.
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Inventory:

- Each inventory item must have a unique identifier, name, and description.
- Stock level, unit price, and supplier information are relevant fields.
- Reorder point can be set to automatically trigger restocking.
- Parts used for maintenance should be deducted from inventory records.

Vehicle Location:

- (Optional) Vehicle location tracking can provide realtime or historical data.
- GPS coordinates, address, and timestamp can be captured.
- Location data can be used for route tracking, theft prevention, and driver safety monitoring.

Additional Rules:

- User access control should be implemented based on roles and permissions.
- Regular data backups and system maintenance are crucial.
- Compliance with relevant regulations regarding vehicle safety and maintenance should be ensured.
- The system should be adaptable to accommodate future changes and integration.

Description of relationships:

- Vehicle has Maintenance (1:N) Relationship Name: Perform Maintenance:

This relationship describes that each vehicle can have multiple maintenance records, but each maintenance record is associated with only one vehicle.

Cardinality:

1: Each vehicle (one) can have multiple maintenance records.

N: Each maintenance record (many) is associated with only one vehicle.

Example: A vehicle undergoes regular maintenance checks. Each maintenance check is recorded as a separate maintenance record but is linked to the specific vehicle that underwent the maintenance.

- Vehicle has Fuel (1:N) Relationship Name: Purchase Fuel:

This relationship indicates that each vehicle can have multiple fuel purchase records, but each fuel purchase record is linked to only one vehicle.

Cardinality:

1: Each vehicle (one) can have multiple fuel purchase records.

N: Each fuel purchase record (many) is associated with only one vehicle.

Example: Whenever a vehicle is refueled, a record is created for that fuel purchase, detailing the amount of fuel purchased and the associated vehicle.

- Vehicle has Trip (1:N) Relationship Name: Undertake Trip:

This relationship signifies that each vehicle can undertake multiple trips, but each trip is associated with only one vehicle.

Cardinality:

1: Each vehicle (one) can undertake multiple trips.

N: Each trip (many) is associated with only one vehicle.

Example: A vehicle is used for various trips such as deliveries or client visits. Each trip is recorded separately but is tied to the specific vehicle used for that trip.

- Driver has Trip (M:N) Relationship Name: Participate in Trip:

This relationship shows that each driver can participate in multiple trips, and each trip can involve multiple drivers.

Cardinality:

M: Each driver (many) can participate in multiple trips.

N: Each trip (many) can involve multiple drivers.

Example: A delivery service may assign multiple drivers to a single delivery trip, or a long-distance journey may involve multiple drivers taking turns driving the same vehicle.

Maintenance has Inventory (1:M) Relationship Name: Utilize Parts:

This relationship indicates that each maintenance record may utilize multiple inventory parts, and each inventory part may be used in multiple maintenance records.

Cardinality:

1: Each maintenance record (one) can utilize multiple inventory parts.

M: Each inventory part (many) may be used in multiple maintenance records.

Example: During a maintenance check, multiple parts from inventory, such as filters or fluids, may be utilized. Each maintenance record lists the parts used, and these parts may be used in multiple maintenance activities.

- Vehicle has Location (1:N) Relationship Name: Track Location:

This relationship suggests that each vehicle may have multiple location tracking records, but each location tracking record is associated with only one vehicle.

Cardinality:

1: Each vehicle (one) can have multiple location tracking records.

N: Each location tracking record (many) is associated with only one vehicle.

Example: If a fleet management system includes GPS tracking, each vehicle's location is tracked at different points in time, and these records are linked to the specific vehicle being tracked.