CPSC 304 Project Cover Page

Milestone #: 2

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Group Number: 94

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By typing our names and student numbers in the above table, we certify that the work in the attached assignment was performed solely by those whose names and student IDs are included above. (In the case of Project Milestone 0, the main purpose of this page is for you to let us know your e-mail address, and then let us assign you to a TA for your project supervisor.)

In addition, we indicate that we are fully aware of the rules and consequences of plagiarism, as set forth by the Department of Computer Science and the University of British Columbia

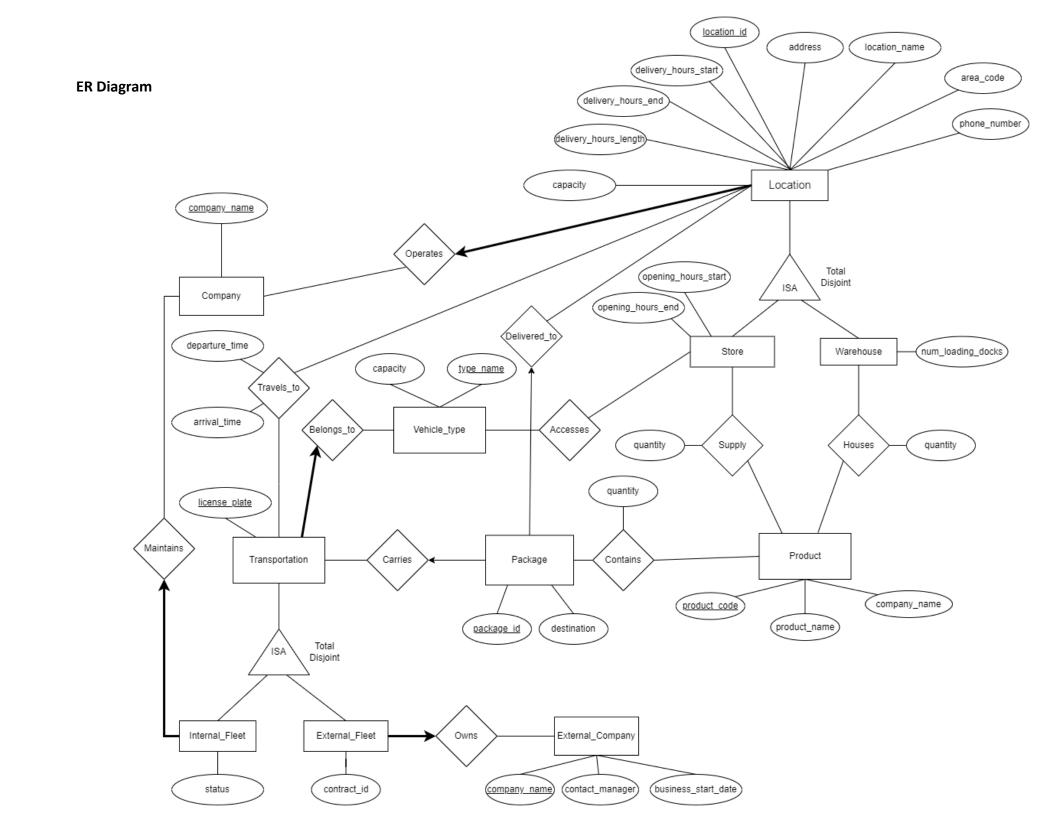
Summary

This application is designed as an inventory tracking system that tracks the status of each package and the quantity of the products in stock. Given a package, a user can view the products it contains and the exact location within the company's internal distribution network, including whether it is currently housed at a location or is in transit between two locations.

ER Diagram

[The ER Diagram is on the following page. Changes made since Module 1 are listed below:]

- Unbolded the lines of the ISA relationships and added the "disjoint, total" text boxes beside the ISA to convey the constraints more clearly.
- Adjusted the attributes of the Transportation ISA subclasses.
- To tackle the confusion of "one item/product can only be stored at a single store location", we combined the brand and the item entity into a product entity. Inside the product entity, a tuple represents a general type of product with information of product_code, product_name, and company_name. Therefore, each store and warehouse can have a certain amount of products.
- We changed the relations from Product to Stores and Locations into many-to-many relationships because each location can have multiple products, for example, a store can have multiple dried mangos produced by company A, and a Product can appear in multiple Locations.
- We changed the relation between Product and Package from one-to-many to many-to-many because different packages can contain the same kind of product. For example, package A and package B both contain dried mango produced by company A.
 We also added a quantity attribute to the Contains relationship to record the amount of a product inside a package.
- Added the Vehicle type entity with the attributes of type name and capacity.
- Added the Accesses relation between Vehicle_type and the Store so that we can know which type of vehicle can access a store, replacing the vehicle_access attribute of Store
- Added the Belongs to the relation between Transportation and Vehicle_type, replacing the vehicle_type attribute of Transportation
- Delivered_to is only populated when a Package arrives at a Location, Stock is only populated when a Package is loaded onto Transportation. The total participation constraints on packages were relaxed.
 - By relaxing the participation constraints on Package and revising the relationships between Package, Transportation, and Location, this scheme should be sufficient to capture package information without a Trips entity.
- Added the destination attribute of a Package to represent its final intended destination.
- Added additional attributes to External Company



Schema

Legend:

Underline: primary key

Bold: foreign key

Note:

For both ISAs, we have decided to use one table for each entity, with excess relationships removed.

- Product(product code: integer, product name, company name: char[30])
 - Candidate Keys: <u>product_code</u>
 - The following must not be NULL:
 - product code, product name, company name
- Supplies(<u>product_code</u>: integer, <u>location_id</u>: integer, quantity: integer)
 - Candidate Keys: (<u>product_code</u>, <u>location_id</u>)
 - The following must not be NULL: product_code, location_id
- Houses(<u>product_code</u>: integer, <u>location_id</u>: integer, quantity: integer)
 - Candidate Keys: (<u>product_code</u>, <u>location_id</u>)
 - o The following must not be NULL: product code, location id
- Contains(product code: integer, package id: integer, quantity: integer)
 - Candidate Keys: (product code, package id)
 - o The following must not be NULL: product code, package id
- Location(<u>location_id</u>: integer, address: char[100], location_name: char[30], area_code: integer, phone_number: integer, delivery_hours_start: time, delivery_hours_end: time, delivery_hours_length: integer, capacity: integer, company_name: char[30])
 - Candidate Keys: <u>location id</u>; (address, location name)
 - Foreign Keys: **company name** REFERENCES Company
 - The following must not be NULL
 - Location id, address, location name, company name, capacity
- Store(<u>location id</u>: integer, opening_hours_start: time, opening_hours_end: time)
 - Candidate Keys: <u>location id</u>
 - Foreign Keys: <u>location id</u> REFERENCES Location
 - The following must not be NULL
 - location_id
- Warehouse(<u>location id</u>: integer, num loading docks: integer)
 - Candidate Keys: location id
 - o Foreign Keys: <u>location_id_</u>REFERENCES Location
 - The following must not be NULL

- location id
- Package(package id, destination: integer, location id: integer, license plate: char[6])
 - Candidate Keys: package id
 - Foreign Keys: location_id REFERENCES Location; license_plate REFERENCES
 Transportation
 - The following attributes must not be null
 - package_id, location_id, destination
- Company(company name: char[30])
 - o Candidate Keys: company name
- Vehicle type(type name: char[30], capacity: integer)
 - Candidate Keys: type name
- Accesses(type name: char[30], **location id**: integer)
 - Candidate Keys: (type name, location id)
 - Foreign Keys: **location id** REFERENCES Locations
- Transportation(<u>license_plate</u>: char[6], **type_name**: char[30])
 - o Candidate Keys: license plate
 - Foreign Keys: type_name REFERENCES Vehicle type
- Internal_Fleet(<u>license_plate</u>: char[6], status: char[10], company_name: char[30])
 - Candidate Keys: <u>license_plate</u>
 - Foreign Keys: <u>license_plate_REFERENCES Transportation</u>; <u>company_name</u>
 REFERENCES Company
- External Fleet(<u>license plate</u>: char[6], contract id: integer, **company_name**: char[30])
 - Candidate Keys: <u>license plate</u>
 - Foreign Keys: <u>license_plate_REFERENCES Transportation</u>; <u>company_name</u>
 REFERENCES Company
- External_Company(company_name: char[30], contact_manager: char[20], business start date: date, license plate: char[6])
 - Candidate Keys: company name
 - Foreign Keys: **license plate** REFERENCES Transportation
- Travels_to(<u>license_plate</u>: char[6], <u>location_id</u>: integer, departure_time: datetime, arrival_time: datetime)
 - Candidate Keys: (<u>license_plate</u>, <u>location_id</u>)

Functional Dependencies

- Product
 - product code → product name
 - product code → company name
- Supplies
 - product_code, location_id → quantity
- Houses
 - product code, location id → quantity
- Contains
 - package_id, product_code → quantity
- Location
 - o address → area code
 - o delivery_hours_start, delivery_hours_end → delivery_hours_length
 - location_id → address
 - location id → location name
 - location id → area code
 - location id → phone number
 - location id → delivery hours start
 - location id → delivery hours end
 - location id → delivery hours length
 - \circ location id \rightarrow capacity
 - o address, location name → location id
 - o address, location name → area code
 - address, location name → phone number
 - o address, location name → delivery hours start
 - address, location_name → delivery_hours_end
 - address, location_name → delivery_hours_length
 - address, location name → capacity
- Store
 - location id → opening hours start
 - location_id → opening_hours_end
- Warehouse
 - location_id → num_loading_docks
- Package
 - package_id → destination
 - package id → location id
 - package id → license plate

- Vehicle type
 - type name → capacity
- Internal_Fleet
 - o license_plate → status
 - license_plate → company_name
- External Fleet
 - License_plate → contract_id
 - License plate → company name
- External Company
 - company_name → contact_manager
 - company_name → business_start_date
 - company_name → Licence_plate
- Transportation
 - license plate → type name
- Travels to
 - license plate, location id → departure time
 - license_plate, location_id → arrival_time

Normalization

- Product, already in BCNF
- Supplies, already in BCNF
- Houses, already in BCNF
- Contains, already in BCNF
- Store, already in BCNF
- Warehouse, already in BCNF
- Company, already in BCNF
- Vehicle_type, already in BCNF
- Access, already in BCNF
- Internal_Fleet, already in BCNF
- External Fleet, already in BCNF
- External_Company, already in BCNF
- Transportation, already in BCNF
- Travels to, already in BCNF
- Location, not in BCNF, so we use decomposition to normalize Location into BCNF form
 - Closures
 - address⁺ = { area code}

- (delivery_hours_start, delivery_hours_end)⁺ = {delivery_hours_start, delivery_hours_length}
- location_id⁺ ={location_id, address, location_name, area_code, phone_number, delivery_hours_start, delivery_hours_end, delivery_hours_length, capacity}
- (address, location_name)⁺ = {location_id, address, location_name, area_code, phone_number, delivery_hours_start, delivery_hours_end, delivery_hours_length, capacity}
- Step1: address → area_code violates the BCNF, decompose:
 R1(address, area_code), R2(address, location_id, location_name, phone_number, delivery_hours_start, delivery_hours_end, delivery_hours_length, capacity, company name)
- Step2: delivery_hours_start, delivery_hours_end → delivery_hours_length violets BCNF, so decompose
 R3(<u>delivery_hours_start, delivery_hours_end,</u> delivery_hours_length),
 R4(address, <u>location_id</u>, location_name, phone_number, delivery_hours_start, delivery_hours_end, capacity, <u>company_name</u>)
- Final answer: R1(<u>address</u>, area_code), R3(<u>delivery_hours_start</u>,
 <u>delivery_hours_end</u>, delivery_hours_length), R4(address, <u>location_id</u>,
 location_name, phone_number, delivery_hours_start, delivery_hours_end,
 capacity, company_name)
- o R1:

■ PK: <u>address</u>

■ CK: address

o R3:

■ PK: <u>delivery hours start, delivery hours end</u>

■ CK: delivery hours start, delivery hours end

o R4:

■ PK: <u>location_id</u>

■ CK: <u>location id</u>, (address, location name);

■ FK: company name

SQL DDL Statements

The SQL DDL statements required to create all the tables from item #5. The statements should use the appropriate foreign keys, primary keys, UNIQUE constraints, etc.

```
CREATE TABLE Product (
        product_code INTEGER PRIMARY KEY,
        product name CHAR(20) NOT NULL,
        company_name CHAR(30) NOT NULL,
);
CREATE TABLE Supplies (
        product_code INTEGER NOT NULL,
        location_id INTEGER NOT NULL,
        quantity INTEGER,
        PRIMARY KEY(product_code, location_id)
);
CREATE TABLE Houses (
        product_code INTEGER NOT NULL,
        location_id INTEGER NOT NULL,
        quantity INTEGER,
        PRIMARY KEY(product_code, location_id)
);
CREATE TABLE Contains(
        product_code INTEGER NOT NULL,
        package_id INTEGER NOT NULL,
        quantity INTEGER,
        PRIMARY KEY(product_code, package_id)
);
CREATE TABLE Locations_R1(
        address CHAR(100) PRIMARY KEY,
        area code INTEGER,
);
CREATE TABLE Locations_R3(
        delivery_hours_start TIME,
        delivery_hours_end TIME,
        delivery_hours_length INTEGER,
        PRIMARY KEY (delivery_hours_start, delivery_hours_end)
);
CREATE TABLE Locations_R4 (
        address CHAR(100) NOT NULL,
        location id INT,
        location_name CHAR(30) NOT NULL,
        phone_number INT,
        delivery hours start TIME,
        delivery_hours_end TIME,
```

```
company_name CHAR(30) NOT NULL,
        capacity INT NOT NULL,
        PRIMARY KEY (location id),
        UNIQUE (address, location_name)
        FOREIGN KEY (company_name) REFERENCES Company
);
CREATE TABLE Store(
        location_id INTEGER PRIMARY KEY,
        opening_hours_start TIME,
        opening_hours_end TIME,
        FOREIGN KEY (location_id) REFERENCES Location_R4
);
CREATE TABLE Warehouse(
        location_id INTEGER PRIMARY KEY,
        num_loading_docks INTEGER,
        FOREIGN KEY (location_id) REFERENCES Locations_R4
);
CREATE TABLE Package(
        package_id INTEGER PRIMARY KEY,
        destination INTEGER NOT NULL,
        location_id INTEGER,
        license plate CHAR(6),
        FOREIGN KEY (location_id) REFERENCE Location_R4,
        FOREIGN KEY (license plate) REFERENCE Transportation
);
CREATE TABLE Company (
        company_name CHAR(30) PRIMARY KEY
);
CREATE TABLE Vehicle_type(
        type_name CHAR(30) PRIMARY KEY,
        capacity INTEGER,
        FOREIGN KEY (location_id) REFERENCES location_R4
);
CREATE TABLE Transportation (
        license_plate CHAR(6),
        type name CHAR(30),
        PRIMARY KEY (license_plate),
```

```
FOREIGN KEY (type_name) REFERENCES Vehicle_type
);
CREATE TABLE Accesses(
        type_name CHAR(30),
        location_id INTEGER,
        PRIMARY KEY (type_name, location_id),
        FOREIGN KEY (location id) REFERENCES Location R4
);
CREATE TABLE Internal_Fleet (
        license_plate CHAR(6),
        status CHAR(16),
        company_name CHAR(30),
        PRIMARY KEY (license plate),
        FOREIGN KEY(company_name) REFERENCES Company,
        FOREIGN KEY(license_plate) REFERENCES Transportation
);
CREATE TABLE External_Fleet (
        license_plate CHAR(6),
        contract_id INT,
        company_name CHAR(30),
        PRIMARY KEY (license_plate),
        FOREIGN KEY(company_name) REFERENCES Company,
        FOREIGN KEY(license_plate) REFERENCES Transportation
);
CREATE TABLE External_Company (
        company_name CHAR(30),
        contact_manager CHAR(20),
        business_start_date DATE,
        PRIMARY KEY (company_name)
);
CREATE TABLE Travels_to (
        license_plate CHAR(6),
        location_id INT,
        departure_time DATETIME,
        arrival time DATETIME,
        PRIMARY KEY (license_plate,location_id)
);
```

INSERT Statements

INSERT statements to populate each table with at least 5 tuples. You will likely want to have more than 5 tuples so that you can have meaningful queries later on.

```
INSERT INTO Product
VALUES (1, "Dried Mangoes", "Mango Republic");
INSERT INTO Product
VALUES (2, "Mango Juice", "Mango Republic");
INSERT INTO Product
VALUES (3, "Canned Peas", "Canton Canning Company");
INSERT INTO Product
VALUES (4, "Canned Tomatoes", "Canton Canning Company");
INSERT INTO Product
VALUES (5, "Eraser", "Resare Limited");
INSERT INTO Supplies
VALUES (1, 103, 12);
INSERT INTO Supplies
VALUES (1, 104, 16);
INSERT INTO Supplies
VALUES (1, 104, 8);
INSERT INTO Supplies
VALUES (2, 103, 2);
INSERT INTO Supplies
VALUES (4, 105, 12);
INSERT INTO Houses
VALUES (1, 226, 50);
INSERT INTO Houses
VALUES (2, 226, 64);
INSERT INTO Houses
VALUES (1, 223, 81);
INSERT INTO Houses
VALUES (2, 213, 100);
INSERT INTO Houses
VALUES (1, 215, 10);
INSERT INTO Contains
VALUES (1, 1101, 20);
INSERT INTO Contains
VALUES (2, 1101, 12);
INSERT INTO Contains
VALUES (1, 1102, 10);
INSERT INTO Contains
VALUES (3, 1103, 20);
```

```
INSERT INTO Contains
VALUES (1, 1103, 10);
INSERT INTO Locations_R1
VALUES ("10800 170 Street, Surrey, BC", 604);
INSERT INTO Locations_R1
VALUES ("57098 E Bakerview Road", 360);
INSERT INTO Locations_R1
VALUES ("6400 Macdonald Street, Vancouver, BC", 604);
INSERT INTO Locations R1
VALUES ("4900 Minoru Boulevard, Richmond, BC", 604);
INSERT INTO Locations_R1
VALUES ("3600 28 Avenue, Delta, BC", 604);
INSERT INTO Locations R1
VALUES ("10900 180 Street, Surrey, BC", 604);
INSERT INTO Locations R1
VALUES ("2700 King Road, Abbotsford, BC", 604);
INSERT INTO Locations_R1
VALUES ("5080 Pacific Street, Bellingham, WA", 360);
INSERT INTO Locations R1
VALUES ("9000 Steveston Highway, Richmond, BC", 604);
INSERT INTO Locations_R1
VALUES ("300 Low level Rd, North Vancouver, BC", 604);
INSERT INTO Locations_R3
VALUES (18:00, 1:00, 7);
INSERT INTO Locations R3
VALUES (19:00, 4:00, 9);
INSERT INTO Locations_R3
VALUES (18:00, 2:00, 8);
INSERT INTO Locations R3
VALUES (6:00, 18:00, 12);
INSERT INTO Locations_R3
VALUES (4:00, 18:00, 14);
INSERT INTO Locations_R4
VALUES (101, "10800 170 Street, Surrey, BC", "AAA Market Surrey", 5556666, 18:00, 1:00, 1000, "AAA Canada");
INSERT INTO Location
VALUES (102, "57098 E Bakerview Road", Bellingham, WA", "AAA Market Bellingham", 7779999, 19:00, 4:00, 1500,
"AAA US");
INSERT INTO Location
VALUES (103, "6400 Macdonald Street, Vancouver, BC", "AAA Market Vancouver", 6663333, 18:00, 2:00, 2000, "AAA
Canada")
INSERT INTO Location
VALUES (104, "4900 Minoru Boulevard, Richmond, BC", "AAA Market Richmond", 6662222, 18:00, 2:00,, 2000, "AAA
Canada")
```

```
INSERT INTO Location
VALUES (105, "3600 28 Avenue, Delta, BC", "AAA Market Delta", 6661111, 18:00, 1:00, 1000, "AAA Canada")
INSERT INTO Locations
VALUES (223, "10900 180 Street, Surrey, BC", "AAA Warehouse 23", 5557777, 6:00, 18:00, 15000, "AAA North
America")
INSERT INTO Location
VALUES (226, "2700 King Road, Abbotsford, BC", "AAA Warehouse 26", 5558888, 6:00, 18:00, 15000, "AAA North
America")
INSERT INTO Location
VALUES (213, "5080 Pacific Street, Bellingham, WA", "AAA Warehouse 13", 1112222, 6:00, 18:00, 15000, "AAA
North America")
INSERT INTO Location
VALUES (215, "9000 Steveston Highway, Richmond, BC", "AAA Warehouse 15", 5553333, 6:00, 18:00, 15000, "AAA
North America")
INSERT INTO Location
VALUES (218, "300 Low level Rd, North Vancouver, BC", "AAA Warehouse 18", 5552222, 4:00, 18:00, 7000, "AAA
North America"
);
INSERT INTO Store
VALUES (101, 10:00, 18:00);
INSERT INTO Store
VALUES (102, 10:00, 19:00);
INSERT INTO Store
VALUES (103, 10:00, 18:00);
INSERT INTO Store
VALUES (104, 10:00, 18:00);
INSERT INTO Store
VALUES (105, 10:00, 18:00);
INSERT INTO Warehouse
VALUES (223, 6);
INSERT INTO Warehouse
VALUES (226, 7);
INSERT INTO Warehouse
VALUES (213, 10);
INSERT INTO Warehouse
VALUES (215, 4);
INSERT INTO Warehouse
VALUES (218, 12);
VALUES (1101, 103, 226, NULL);
INSERT INTO Package
VALUES (1102, 104, 223, NULL);
INSERT INTO Package
```

VALUES (1103, 103, NULL, "ABC 148");

```
INSERT INTO Package
VALUES (1104, 101, NULL, "CDE 789");
INSERT INTO Package
VALUES (1105, 213, NULL, "BCD 259");
INSERT INTO Company
VALUES ("AAA Canada");
INSERT INTO Company
VALUES ("AAA US");
INSERT INTO Company
VALUES ("AAA North America");
INSERT INTO Company
VALUES ("AAA Global");
INSERT INTO Company
VALUES ("AAA Quebec");
INSERT INTO Vehicle type
VALUES ("box_truck", 100);
INSERT INTO Vehicle_type
VALUES ("18_wheel", 500);
INSERT INTO Vehicle type
VALUES ("pickup", 50);
INSERT INTO Vehicle type
VALUES ("van", 75);
INSERT INTO Vehicle_type
VALUES ("flatbed", 200);
INSERT INTO Transportation
VALUES ("ABC 148", "box_truck");
INSERT INTO Transportation
VALUES ("CDE 789", "box_truck");
INSERT INTO Transportation
VALUES ("DEF 232", "box_truck");
INSERT INTO Transportation
VALUES ("FGH 124", "box_truck");
INSERT INTO Transportation
VALUES ("GHI 616", "box_truck");
INSERT INTO Transportation
VALUES ("BCD 259", "18_wheel");
INSERT INTO Transportation
VALUES ("EFG 343", "18_wheel");
INSERT INTO Transportation
VALUES ("HIJ 120", "18_wheel");
INSERT INTO Transportation
VALUES("IJK 987", "18_wheel");
INSERT INTO Transportation
```

```
VALUES("JKL 676", "18_wheel");
INSERT INTO Accesses
VALUES ("box_truck", 101);
INSERT INTO Accesses
VALUES ("18_wheel", 101);
INSERT INTO Accesses
VALUES ("box_truck", 102);
INSERT INTO Accesses
VALUES ("box truck", 103);
INSERT INTO Accesses
VALUES ("box_truck", 104);
INSERT INTO Accesses
VALUES ("box truck", 105);
INSERT INTO Accesses
VALUES ("18_wheel", 105);
INSERT INTO Internal_Fleet
VALUES ("ABC 148", "delivery", "AAA North America");
INSERT INTO Internal Fleet
VALUES ("CDE 789", "delivery", "AAA North America");
INSERT INTO Internal_Fleet
VALUES ("DEF 232", "maintenance", "AAA North America");
INSERT INTO Internal Fleet
VALUES ("FGH 124", "maintenance", "AAA North America");
INSERT INTO Internal_Fleet
VALUES ("GHI 616", "standby", "AAA North America");
INSERT INTO External_Fleet
VALUES ("BCD 259", "18_wheel", "YYY Logistics");
INSERT INTO External Fleet
VALUES ("EFG 343", "18_wheel", "YYY Logistics");
INSERT INTO External_Fleet
VALUES ("HIJ 120", "18_wheel", "YYY Logistics");
INSERT INTO External_Fleet
VALUES("IJK 987", "18_wheel", "RSE Global Transport");
INSERT INTO External Fleet
VALUES("JKL 676", "18_wheel", "LHD");
INSERT INTO External_Company
VALUES ("FedUp", "6044440044", August 17, 2018);
INSERT INTO External Company
VALUES ("LHD", "6045550055", August 18, 2019);
INSERT INTO External_Company
VALUES ("YYY Logistics", "6047770077", January 29, 2013);
INSERT INTO External_Company
```

VALUES ("RSE Global Transport", "6042220022", February 10, 2014); INSERT INTO External_Company VALUES ("Global Leap", "6041110011", February 29, 2020);

INSERT INTO Travels_to
VALUES ("ABC 148", 103, 2023-02-20 12:00:00, 2023-06-20 12:00:00);
INSERT INTO Travels_to
VALUES ("CDE 789", 101, 2023-02-20 12:00:00, 2023-06-20 12:00:00);
INSERT INTO Travels_to
VALUES ("GHI 616", 103, 2023-06-20 12:00:00, 2023-06-22 12:00:00);
INSERT INTO Travels_to
VALUES ("BCD 259", 213, 2023-02-24 12:00:00, 2023-05-20 12:00:00);
INSERT INTO Travels_to
VALUES ("IJK 987", 215, 2023-05-10 12:00:00, 2023-05-12 12:00:00);