

Database Narrative:

The Flight Management System (FMS) database serves as the backbone of an integrated system for managing flight-related operations in an airline company. It encompasses tables that capture critical information regarding personnel, flights, airlines, aircraft, routes, passengers, and airports. This system ensures seamless airline operations, including reservations, scheduling, and reporting.

This database is designed to ensure that all users, including passengers and customer service representatives, have easy access to comprehensive information about airlines and their associated details. Passengers should find it user-friendly when checking their ticket status, making new bookings, and accessing flight schedules. Customer service representatives should also find it convenient to provide prompt and accurate assistance to passengers, contributing to a high level of customer satisfaction.

Users:

1. **Passengers:** End-users of the system, responsible for booking and managing their flights.
 - **Information Needs:**
 - Access to flight schedules, availability, and pricing.
 - Ability to reserve, modify, and cancel flights.
 - View and print booking confirmations.
2. **Customer Support Representatives:** Employees responsible for assisting passengers with their bookings and inquiries.
 - **Information Needs:**
 - Ability to search for flights and provide information on availability and pricing.
 - Assist with booking modifications, cancellations, and issue resolution.
3. **Flight Crew:** Personnel involved in the actual operation of flights (pilots, flight attendants).
 - **Information Needs:**
 - Access to flight schedules, routes, and passenger manifests.
 - Flight status updates and emergency contact information.
4. **Management:** Higher-level executives responsible for strategic planning and decision-making.
 - **Information Needs:**

- Analytical reports on overall performance, revenue, and customer trends.
- Long-term planning based on historical data and market trends.

To guarantee that these particulars are well stored and readily accessible to both passengers and customer service representatives, I intend to use the following tables in my database for an enhanced product.

TABLES	DESCRIPTION
PERSONS	This table contains personal information about individuals associated with the system, including both employees and passengers.
EMPLOYEES	This table is a subset of the `PERSONS` table, specifically for employees. It holds additional information about their employment.
PASSENGERS	This table is a subset of the `PERSONS` table, containing details specific to passengers.
AIRLINES	This table contains information about various airlines operating.
AIRCRAFTS	This table provides details about different aircrafts utilized by the airlines.
ROUTES	This table defines different routes that can be taken by flights.
FLIGHTS	This table contains details about individual flights, including information about the aircraft, route, and scheduling.
FLIGHT_STATUSES	This table keeps track of the statuses of various flights.
PASSENGERS_ON_FLIGHTS	This table establishes the association between passengers and the flights they are booked on.
AIRPORTS	This table contains information about different airports including their locations and time zones.

Data Dictionary:

Table Name	Attribute Name	Contents	Data Type	Format	Range	Required	PK/FK	Reference
PERSONS	PERSON_ID	Person ID code	INT(5)	99999	0 – 99999	Y	PK	
	PERSON_FNAME	Person First Name	VARCHAR(30)	Xxxxxx		Y		
	PERSON_LNAME	Person Last Name	VARCHAR(30)	Xxxxxx		Y		
	PERSON_DOB	Person Date of Birth	DATE	yyyy-mm-dd		Y		
	PERSON_GENDER	Person Gender(M or F)	CHAR(1)	X		Y		
	PERSON_EMAIL	Person Email address	VARCHAR(256)	Xxxxxx@xxx		Y		
	PERSON_PHONE	Person Primary Phone Number	CHAR(15)	XXX-XXX-XXXX		Y		
EMPLOYEES	EMP_ID	Employee ID Code	INT(5)	99999	0 – 99999	Y	PK	
	PERSON_ID	Person ID code	INT(5)	99999	0 – 99999	Y	FK	PERSONS
	HIRE_DATE	Hiring date of the employee	DATE	yyyy-mm-dd		Y		
	HOURLY_WAGE_USD	Hourly Wages in USD	DECIMAL(10,2)	99999999.99	0.01 – 99999999.99	Y		
	JOB_TITLE	Title of the employee	VARCHAR(30)	Xxxxxxx		Y		
PASSENGERS	PASSENGER_ID	Passenger ID code	INT(5)	99999	0 – 99999	Y	PK	
	PERSON_ID	Person ID code	INT(5)	99999	0 – 99999	Y	FK	PERSONS
	TSA_REDRRESS_NUM	TSA redress number	CHAR(13)	XXXXXX XXXXXX XXX		Y		
	KNOWN_PASSENGER_NUM	Known passenger number	CHAR(5)	XXXXXX		Y		
	NEEDS_SPECIAL_ASSISTANCE	Passenger need assistance	BOOLEAN	0/1	0-1	Y		
AIRLINES	AIRLINE_ID	Airline ID code	INT(5)	99999	0 – 99999	Y	PK	
	AIRLINE_NAME	Airline Name	VARCHAR(50)	Xxxxxxx		Y		
	AIRLINE_COUNTRY	Country where the airline is based.	VARCHAR(50)	Xxxxxxx		Y		

	AIRLINE_CODE	ICAO code of the airline.	VARCHAR(10)	Xxxxxx		Y		
	AIRLINE_FOUNDED_YEAR	Airline founded year	CHAR(13)	XXXXXX XXXXXX XXX		Y		
AIRCRAFTS	AIRCRAFT_ID	Aircraft ID Code	INT(5)	99999	0 – 99999	Y	PK	
	AIRLINE_ID	Airline ID code	INT(5)	99999	0 – 99999	Y	FK	AIRLINES
	AIRCRAFT_MANUFACTURER	Aircraft manufacturer company	VARCHAR(50)	Xxxxxx		Y		
	AIRCRAFT_MODEL	Aircraft Model	VARCHAR(50)	Xxxxxx		Y		
	AIRCRAFT_CAPACITY	Aircraft seat capacity	INT(5)	99999	0 – 99999	Y		
FLIGHTS	FLIGHT_ID	Flight ID Code	INT(5)	99999	0 – 99999	Y	PK	
	AIRLINE_ID	Airline ID code	INT(5)	99999	0 – 99999	Y	FK	AIRLINES
	AIRCRAFT_ID	Aircraft ID Code	INT(5)	99999	0 – 99999	Y	FK	AIRCRAFTS
	STATUS_ID	Flight Status ID code	INT(5)	99999	0 – 99999	Y	FK	FLIGHT_STATUSES
	ROUTE_ID	Route ID code	INT(5)	99999	0 – 99999	Y	FK	ROUTES
	BASE_PRICE_USD	Base price in USD	DECIMAL(10,2)	99999999.99	0.01 – 99999999.99	Y		
	DEPARTURE_TIME	Flight departure time scheduled	DATETIME	Yyyy-mm-dd Hh:mm:ss		Y		
	ARRIVAL_TIME	Flight Arrival time scheduled	DATETIME	Yyyy-mm-dd Hh:mm:ss		Y		
	AVAILABLE_SEATS	Seats available in the flight	INT(5)	99999	0 – 99999	Y		
FLIGHT_STATUSES	STATUS_ID	Flight Status ID code	INT(5)	99999	0 – 99999	Y	PK	
	FLIGHT_ID	Flight ID Code	INT(5)	99999	0 – 99999	Y	FK	FLIGHTS
	ACTUAL_DEPARTURE_TIME	Flight departure time Actual	DATETIME	Yyyy-mm-dd Hh:mm:ss		Y		

	ACTUAL_ARRIVAL_TIME	Flight Arrival time actual	DATETIME	Yyyy-mm-dd Hh:mm:ss		Y		
	STATUS	Description of the flight status	VARCHAR(50)	Xxxxxx		Y		
ROUTES	ROUTE_ID	Route ID code	INT(5)	99999	0 – 99999	Y	PK	
	ORIGIN_AIRPORT_ID	Origin airport id for the flight	INT(5)	99999	0 – 99999	Y	FK	AIRPORTS
	DESTINATION_AIRPORT_ID	Destination airport id for the flight	INT(5)	99999	0 – 99999	Y	FK	AIRPORTS
	AIRCRAFT_ID	Aircraft ID Code	INT(5)	99999	0 – 99999	Y	FK	AIRCRAFTS
	DISTANCE	Distance between Origin and destination	DECIMAL(10,2)	99999999.99	0.01 – 99999999.99	Y		
AIRPORTS	AIRPORT_ID	Airport ID code	INT(5)	99999	0 – 99999	Y	PK	
	AIRPORT_NAME	Name of the Airport	VARCHAR(100)	Xxxxxx		Y		
	AIRPORT_CITY	Name of the airport city	VARCHAR(50)	Xxxxxx		Y		
	AIRPORT_COUNTRY	Name of the airport Country	VARCHAR(50)	Xxxxxx		Y		
	AIRPORT_TIMEZONE	Timezone of airport	VARCHAR(50)	Xxxxxx		Y		
PASSENGERS_ON_FLIGHTS	FLIGHT_ID	Flight ID Code	INT(5)	99999	0 – 99999	Y	PK,FK	FLIGHTS
	PASSENGER_ID	Passenger ID code	INT(5)	99999	0 – 99999	Y	PK,FK	PASSENGERS
	SEAT_NUMBER	Seat Number associated with passenger	CHAR(3)	XXX		Y		
	MEAL_PREFERENCE	Veg or Non-veg preference	CHAR(13)	XXXXXX XXXXXX XXX		Y		
	SERVICE_LEVEL	Service level chosen by passenger	CHAR(13)	XXXXXX XXXXXX XXX		Y		

Business Rule:

1. PERSONS is an (0:1) EMPLOYEES:
 - A person may or may not be an employee, but each employee is associated with only one person.
2. PERSONS is a (0:1) PASSENGERS:
 - A person may or may not be a passenger, but each passenger is associated with only one person.
3. AIRLINES own (1:M) AIRCRAFTS:
 - An airline can own multiple aircraft, but each aircraft is owned by only one airline.
4. AIRLINES operate (1:M) FLIGHTS:
 - An airline can operate multiple flights, but each flight is operated by only one airline.
5. PASSENGERS travels in (M:N) FLIGHTS:
 - A passenger can travel in multiple flights, and a flight can have multiple passengers.
6. AIRCRAFTS used for (1:M) FLIGHTS:
 - An aircraft can be used for multiple flights, but each flight is associated with only one aircraft.
7. AIRCRAFTS used in (1:M) ROUTES:
 - An aircraft can be used in multiple routes, but each route is associated with only one aircraft.
8. FLIGHTS has a (1:1) FLIGHTS_STATUSES:
 - Each flight has one and only one status, and each flight status is associated with only one flight.
9. AIRPORTS used for (1:M) ROUTES:
 - An airport can be used for multiple routes, but each route is associated with only one airport.

10. FLIGHTS_STATUSES for a (1:M) FLIGHTS:

- Each flight status can be associated with multiple flights, but each flight is associated with only one status.

11. ROUTES having (1:M) FLIGHTS:

- Each route can have multiple flights, but each flight is associated with only one route.

Entity Relationship Model (ERM):

<u>ENTITY</u>	<u>RELATIONSHIP</u>	<u>CONNECTIVITY</u>	<u>ENTITY</u>
PERSONS	is an	(0:1)	EMPLOYEES
PERSONS	is a	(0:1)	PASSENGERS
AIRLINES	own	(1:M)	AIRCRAFTS
AIRLINES	operate	(1:M)	FLIGHTS
PASSENGERS	travels in	(M:N)	FLIGHTS
AIRCRAFTS	used for	(1:M)	FLIGHTS
AIRCRAFTS	used in	(1:M)	ROUTES
FLIGHTS	has a	(1:1)	FLIGHTS_STATUSES
AIRPORTS	used for	(1:M)	ROUTES
FLIGHTS_STATUSES	for a	(1:M)	FLIGHTS
ROUTES	having	(1:M)	FLIGHTS

Relational Scheme:

PERSONS (**PERSON ID**, PERSON_FNAME, PERSON_LNAME, PERSON_DOB,
PERSON_GENDER, PERSON_EMAIL, PERSON_PHONE)

EMPLOYEES (**EMP ID**, PERSON_ID, HIRE_DATE, HOURLY_WAGE_USD, JOB_TITLE)

PASSENGERS (**PASSENGER ID**, PERSON_ID, TSA_REDRESS_NUM,
KNOWN_PASSENGER_NUM, NEEDS_SPECIAL_ASSISTANCE)

AIRLINES (**AIRLINE ID**, AIRLINE_NAME, AIRLINE_COUNTRY, AIRLINE_CODE,
AIRLINE_FOUNDED_YEAR)

AIRCRAFTS (**AIRCRAFT ID**, AIRLINE_ID, AIRCRAFT_MANUFACTURER,
AIRCRAFT_MODEL, AIRCRAFT_CAPACITY)

FLIGHTS (**FLIGHT ID**, AIRLINE_ID, AIRCRAFT_ID, STATUS_ID, ROUTE_ID,
BASE_PRICE_USD, DEPARTURE_TIME, ARRIVAL_TIME, AVAILABLE_SEATS)

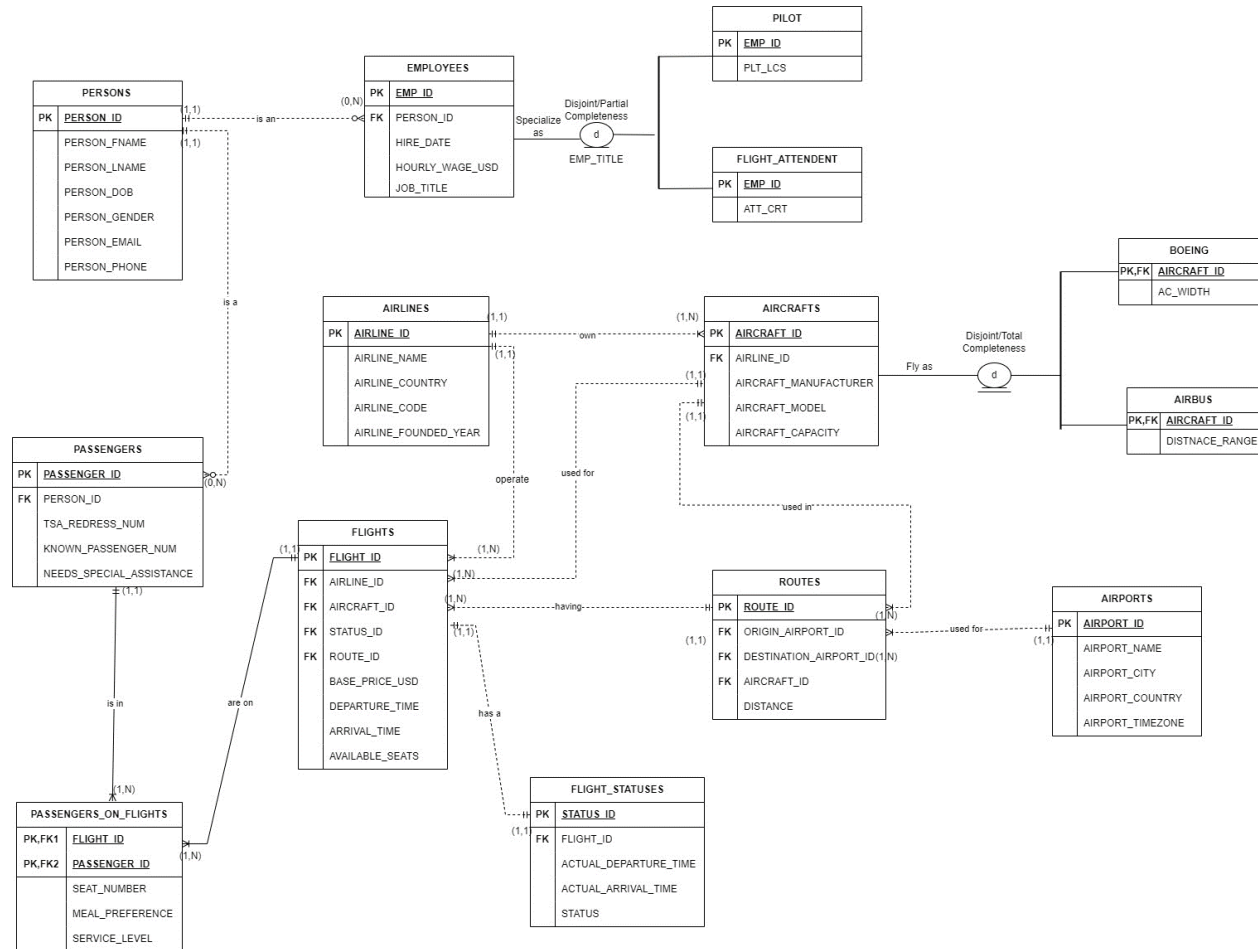
FLIGHT_STATUSES (**STATUS ID**, FLIGHT_ID, ACTUAL_DEPARTURE_TIME,
ACTUAL_ARRIVAL_TIME, STATUS)

ROUTES (**ROUTE ID**, ORIGIN_AIRPORT_ID, DESTINATION_AIRPORT_ID, AIRCRAFT_ID,
DISTANCE)

AIRPORTS (**AIRPORT ID**, AIRPORT_NAME, AIRPORT_CITY, AIRPORT_COUNTRY,
AIRPORT_TIMEZONE)

PASSENGERS_ON_FLIGHTS (**FLIGHT ID**, **PASSENGER ID**, SEAT_NUMBER,
MEAL_PREFERENCE, SERVICE_LEVEL)

Crow's Foot notation ERD for relationship between all the tables with supertype and subtype diagrams:

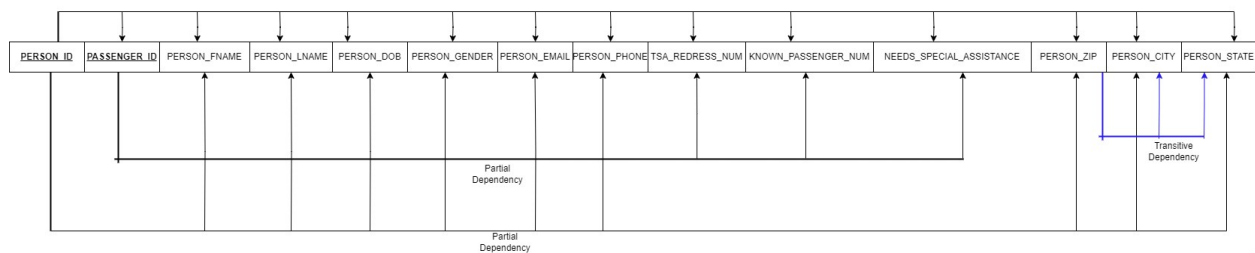


Documented walk through of the Normalized table:

A description documenting a table's transition into 1NF:

1NF: Below is an example of 1NF which has partial dependency as well as transitive dependency.

PERSON (PERSON_ID, PASSENGER_ID, PERSON_FNAME, PERSON_LNAME, PERSON_DOB, PERSON_GENDER, PERSON_EMAIL, PERSON_PHONE, TSA_REDRESS_NUM, KNOWN_PASSENGER_NUM, NEEDS_SPECIAL_ASSISTANCE, PERSON_ZIP, PERSON_CITY, PERSON_STATE)



In the above diagram, we can see that it has primary key through which we can find out a unique record. However, this table contains Partial and Transitive dependencies. So, this is in 1NF form. Below is the relational schema for partial and transitive dependency:

PARTIAL DEPENDENCIES:

PERSON (PERSON_ID -> PERSON_FNAME, PERSON_LNAME, PERSON_DOB, PERSON_GENDER, PERSON_EMAIL, PERSON_PHONE, PERSON_ZIP, PERSON_CITY, PERSON_STATE)

PASSENGER (PASSENGER_ID -> TSA_REDRESS_NUM, KNOWN_PASSENGER_NUM, NEEDS_SPECIAL_ASSISTANCE)

TRANSITIVE DEPENDENCY:

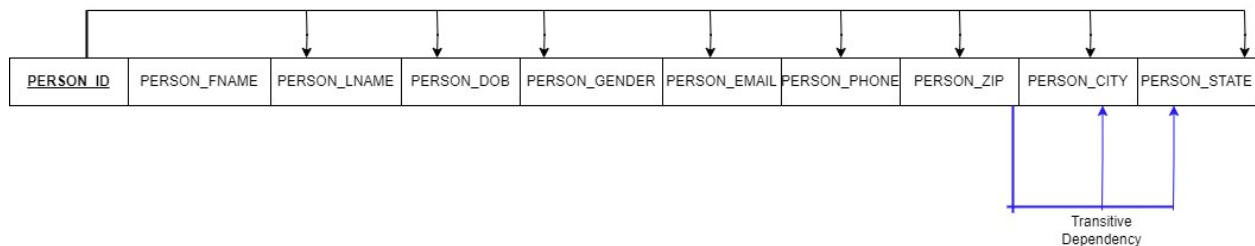
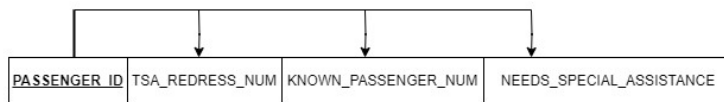
LOCATION (PERSON_ZIP -> PERSON_CITY, PERSON_STATE)

To set to 2NF, the partial dependencies must be addressed by separating them into two new tables, with the determinate attributes being singular primary keys for said tables. These tables will be tables PERSON and PASSENGER.

A description documenting a table's transition into 2NF:

PASSENGER (**PASSENGER ID**, TSA_REDRESS_NUM, KNOWN_PASSENGER_NUM, NEEDS_SPECIAL_ASSISTANCE)

PERSON (**PERSON ID**, PERSON_FNAME, PERSON_LNAME, PERSON_DOB, PERSON_GENDER, PERSON_EMAIL, PERSON_PHONE, PERSON_ZIP, PERSON_CITY, PERSON_STATE)



In the above diagram, we can see that there are no pending PARTIAL dependencies, and we have PRIMARY key to uniquely identifying rows.

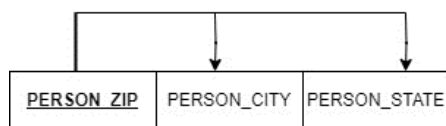
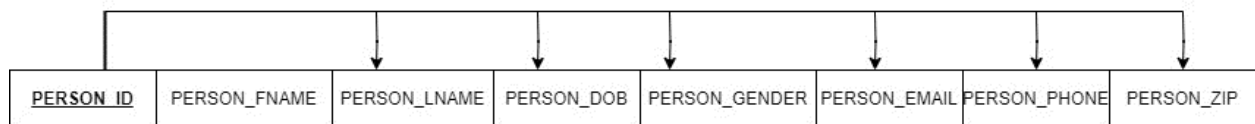
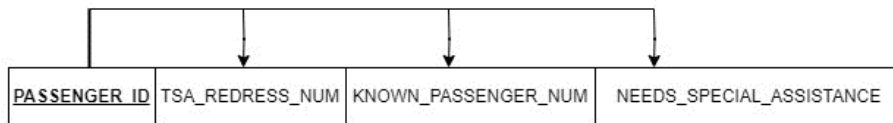
We also have pending TRANSITIVE dependency which will be resolved when we perform 2NF-3NF transitions.

A description documenting a table's transition into 3NF:

PASSENGER (**PASSENGER_ID**, TSA_REDRESS_NUM, KNOWN_PASSENGER_NUM, NEEDS_SPECIAL_ASSISTANCE)

PERSON (**PERSON_ID**, PERSON_FNAME, PERSON_LNAME, PERSON_DOB, PERSON_GENDER, PERSON_EMAIL, PERSON_PHONE, PERSON_ZIP)

LOCATION (**PERSON_ZIP**, PERSON_CITY, PERSON_STATE)



In the above diagram the Diagram from 2NF has been broken into more Entities. Now every aspect is assigned to a new separate table. Both partial and transitive dependencies have been eliminated now. So, the tables are 3NF now.

Questions with their Associated Queries:

Question1. What is the phone number of a person with First Name Bhavya and Last Name Aggarwal.

```
SELECT PERSON_PHONE  
  
FROM PERSONS  
  
WHERE PERSON_FNAME = 'Bhavya' AND PERSON_LNAME = 'Aggarwal';
```

Question2. What is the Known passenger number and Person Date of Birth for a person with First Name Bhavya and Last Name Aggarwal.

```
SELECT PASSENGERS.KNOWN_PASSENGER_NUM, PERSONS.PERSON_DOB  
  
FROM PASSENGERS  
  
INNER JOIN PERSONS ON PASSENGERS.PERSON_ID = PERSONS.PERSON_ID  
  
WHERE PERSONS.PERSON_FNAME = 'Bhavya' AND PERSONS.PERSON_LNAME = 'Aggarwal';
```

Question3. Give First Name and Last Name of employees whose Hourly wage is more than 25 USD.

```
SELECT  
  
    PERSONS.PERSON_FNAME,  
  
    PERSONS.PERSON_LNAME  
  
FROM PERSONS  
  
WHERE  
  
    PERSONS.PERSON_ID IN (  
  
        SELECT EMPLOYEES.PERSON_ID  
  
        FROM EMPLOYEES  
  
        WHERE EMPLOYEES.HOURLY_WAGE_USD > 25.00  
  
    );
```