Haramaya University

College of Computing and Informatics

Department of Information Science

Advanced Database Group Project

Title: Airlines Management System

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Chapter 1

1.1 Introduction

Aviation in Ethiopia is a primary enabler of regional connectivity, economic activity and local travel. As much as Ethiopian Airlines is renowned for its international connectivity, the efficiency of its domestic flights is equally crucial for internal trade, tourism and accessibility. This project deals with the design and implementation of Ethiopian Airlines Management Database System with emphasis on Domestic Flights for centralizing and organizing different data processes for domestic flights in Ethiopia. One of the most significant innovations of this system is that it focuses on services to the Haramaya University student body by incorporating an ID-based discount system and providing integrated transport logistics either from the Dire Dawa Airport or from a student's residence to his/her university. This end-to-end solution aims to render air travel more affordable and easier for students and establish a strong basis of data management for certain domestic airline flights and related ground transport.

1.2 Background

Ethiopian Airlines, the national carrier, operates an extensive domestic network connecting principal cities and regions. Successful utilization of these domestic flights, from scheduling and passenger data to ticketing and now ground transportation, is the secret to its success operationally. Existing systems, while workable, might not address the specific niche market segments like university students or provide ground transportation in an integrated manner. The university student body at Haramaya University represents a significant potential customer base for domestic air travel that is generally limited by economics and by the inconvenience of traveling to remote airports. This project deals with the increasing demand for a comprehensive database solution that not only effectively handles domestic flight information and provides student discounts but also provides an integrated experience from student's home/university to destination or domestic airport solving a significant pain point of customers. This project examines how a focused database can enhance service delivery to a niche demographic within the overall airline operations system by providing a more complete travel solution.

1.3 Objective of the Project

The primary objectives of this project are to create and document an entire database solution for Ethiopian Airlines' domestic flights, with particular focus on student passengers from Haramaya University, using ID based discount.

1.3.1 General Objective of the Project

The general objective of this project is to model and design an efficient and integrated relational database system for Ethiopian Airlines' local flight management with online booking, Haramaya University students' discount, thus minimizing the end-to-end travelling complexity by students and other local travellers within Ethiopia.

1.3.1 Specific Objective of the Project

The project-specific goals for this project are:

- ➢ To recognize and examine the most significant needs of Ethiopian Airlines domestic flights such as routes, schedules, planes, and online reservation processes.
- ➢ To support certain data fields and relationships to process Haramaya University student information and facilitate ID-based discounting.
- ➢ In order to create a conceptual schema as an Entity-Relationship Diagram (ERD) that best describes all entities and relationships found.
- ➢ To map the conceptual schema to a logical relational schema, specifying tables, attributes, primary keys, and foreign keys.
- ➢ To implement normalization rules (up to 3NF) for data integrity, reducing redundancy, and maximizing database performance.
- ➢ To design a physical database schema that can be realized in a relational database management system (DBMS).

1.4 Scope

The scope of the Ethiopian Airlines Management Database System for Domestic Flight project covers the following key functional areas, with particular emphasis on the student base and composite transportation:

- ➔ Airport and Route Management: Managing data of all airports in Ethiopia and routes between them.
- ➔ Aircraft Management: Keeping records of airplanes utilized for domestic flights.
- ➔ Domestic Flight Scheduling: Maintaining flight number, departure/arrival time, and flight status of domestic flights within Ethiopia.
- ➔ Passenger Management: Managing total passenger registration and contact details.
- ➔ Haramaya University Student Registration: Special module to register Haramaya University students with their exclusive university ID for discount eligibility.
- ➔ Online Booking and Reservation (Domestic): Facilitating online domestic flight search, selection, and booking, as well as seat reservation and reservation status.
- ➔ Discount Application: Implementing a feature to offer some discounts to Haramaya University students upon their confirmed university ID during online booking.
- ➔ Ticket Issuance: Information of issued e-tickets on domestic flights.
- ➔ Crew Management: Basic management of crew information assigned to domestic flights.

1.5 Limitation

There are certain limitations to this project given its academic scope and particular emphasis:

- Availability of Data and Real-world Complications: The project presumes hypothetical data needs and idealized business pathways instead of real-time data for Ethiopian Airlines or end-to-end transportation service providers. This implies that certain complications of their current systems, sophisticated pricing models, or real-time vehicle tracking are not thoroughly incorporated.
- Real-world Integration Complexity: The database is handled as an isolated system for the sake of this project. It does not account for complexities in integrating with Ethiopian Airlines'

large-scale, legacy, or worldwide operating systems, or with external transport service providers or real-time traffic data.

- Time and Resource Constraints: Academic timeline and lack of access to professional airline industry software, full internal Ethiopian Airlines operations data, or real transport logistics data limited the scope of functional modules and the extent of very specialized functionality (e.g., dynamic home pickup routing).
- Focus in Domestic Flights : The database is to serve domestic flights within Ethiopia mostly. International flight intricacies, laws, and related data points fall beyond the scope of this project.
- Streamlined Discount Authentication: While the process of student discount is architecturally built around ID verification, integration with a university student database or an ID verification system in real time is outside the scope of this project.

1.6 Constraint

The following limitations influenced the designing and development of this database system:

- Database Management System (DBMS): The database schema is to be designed for realization utilizing a relational DBMS (e.g., MySQL, PostgreSQL, SQL Server) according to standard SQL principles.
- Normalization Level: The schema of the database should be in Third Normal Form (3NF) to enable data integrity and reduce redundancy.
- Security Considerations (Conceptual): While not implemented, the design allows for the logical separation of data to enable future security access controls, especially for confidential student and booking information.
- Scalability: The architecture is looking for a foundation that will be scalable to accommodate future growth in data volume and functional requirements for flights.
- Prioritize Core Functionality: The architecture places a higher priority on the core functions of online booking, student discounts, and fundamental transportation logistics than on extremely complex, non-core features.

1.7 Significant of the Project

This project is important to a number of stakeholders:

- For Ethiopian Airlines (Domestic Operations): An integrated database that is properly designed can greatly facilitate the management of domestic flight schedules, aircraft assignment, passenger information, and now ground transportation logistics. This translates to improved efficiency, improved utilization of resources on domestic flights, and a more seamless customer experience.
- For Haramaya University Students: The project outlines the vision for a system that will have a significant impact on university students by providing an affordable, effective domestic air travel experience. The incorporation of ID-based discounts and door-to-door or campus transportation addresses key pain points, with greater mobility for academic, personal, and family needs.
- For Database Students/Developers: This project is a full practical application of basic database design principles to a complex, real-world scenario. It demands the designer to accommodate multiple requirements, e.g., special interest groups of users (students), economic reasons (discounts), and operational challenges (transportation), providing excellent experience in systems thinking and integrated database solutions.
- For Academic Collaboration: Haramaya University partnership paves the way for future collaboration between academia and the airline sector focusing on symbiotic relationships. For
- Future Development: The normalized and structured database gives a solid base for the future development of easy-to-use online booking websites, student travel portals that are dedicated, sophisticated reporting tools, dynamic route planning for transport, and easy integration with other university or airline business systems.

1.8 Methodology

Project methodology consists of a series of significant phases:

- Requirements Analysis: Extensive research was conducted to understand the core operations and data necessities of an Ethiopian Airlines internal flight system, including the extra requirements for online booking, students' discounts. This involved review of available literature, internet sources, and conceptual models of similar integrated travel systems. User stories were the center in determining specific functionalities.

- Conceptual Design: From the gathered requirements, an Entity-Relationship Diagram (ERD) was established to graphically represent the main entities (e.g., Flight, Passenger, Student, Booking, etc), their attributes, and the more intricate relationships between them, independent of any specific database system.
- Logical Design: The ERD was then projected onto a relational schema, such as tables, columns, primary keys, foreign keys, and constraints. The normalization rules (up to 3NF) were carefully applied in this process for data integrity and optimal performance.
- Physical Design: The logical schema was then projected onto specific data types and capabilities of a chosen RDBMS (e.g., SQL Data Definition Language (DDL) statements to define tables).
- Documentation: All the design decisions, schema definitions and diagrams were properly documented to provide a good idea about the database structure and the logic involved.

1.9 User Stories

To improve the database design for Ethiopian Airlines domestic flights, student discount option, online booking, and included transport, a full set of user stories was conceived. The stories are the requirements from the perspective of different users of the system:

- As a Haramaya University Student, I would like to be able to open an online account and input my university ID so that I can reserve flights swiftly and earn student discounts.
- As a Haramaya University Student, I would like to be able to search for domestic flights online between Ethiopian cities so that I can make travel arrangements with ease.
- As a Haramaya University student, I would like to automatically receive the discounted flight rate when I make a domestic flight booking and when I show my student ID to ensure that I am aware of my real travel cost.
- As a General Passenger, I would appreciate being able to search and reserve domestic flights online so that I can travel conveniently within Ethiopia.

1.10 Interview

While literal interviews with Ethiopian Airlines operation staff, Haramaya University administration were not feasible for this intellectual exercise, requirements gathering process simulated questions conceptually to bring out the data flow and operational requirements. We asked questions such as:

- "What are the key data points that are necessary for managing an online domestic flight booking?"
- "How are internal flights and flight schedules typically coordinated and how new data would be needed for online visibility?"
- "What data would be needed to identify a student as qualified for a discount, and to track their university ID?"
- "What are the typical steps of a domestic flight booking from the user's perspective, including discounting?" "What data would be needed to track the use of student discounts and transportation services for reporting?"

Chapter 2

2.1 Body of Work

This chapter records the diligent work carried out when designing the integrated Ethiopian Airlines Management Database System that is an expert in Domestic Flights Database. It discusses how initial requirements, including online reservation, student rebates and ground transport logistics, are transformed into a structured, normalized database schema. The prime focus was on choosing all the key entities of the domestic flights and land transportation of the airline and specifying their characteristics, creating key relationships and ensuring data consistency with proper normalization. All this work results in a logical database design, which is robust, efficient, and physically deployable in a relational DBMS and ready to facilitate an integrated travel experience.

2.2 Database Structure

The Ethiopian Airlines Management Database System for Domestic Flights Database is a relation database composed of numerous interrelated tables. Each table maps to a unique entity in the domestic services of the airline, student administration, or ground transportation services. Individual attributes of the entity are kept in columns of the tables. Primary Keys (PKs) and Foreign Keys (FKs) establish relationships between tables and ensure referential integrity and consistency in the integrated system. The main entities for this entire system are:

Passengers: General passengers utilizing the online booking system.

- ★ Students: Special entity for students of Haramaya University.
- ★ Passenger: Represents any individual flying.
- ★ Airports: Domestic airports within Ethiopia.
- ★ Aircrafts: Domestic route fleet utilized.
- ★ Airline: Represents the airline companies operating flights.
- ★ Flights: Scheduled domestic flights.
- ★ Bookings: Flight booking, now merged with online features and perhaps discounts.
- ★ Discounts: Identifies different kinds of discounts (e.g., student discount).
- ★ CrewMembers: Domestic flight crew.
- ★ CrewAssignments: Crew to flight assignments.

2.3 Conceptual Schema

Entities and their Core Attributes

Student

Attributes: Student ID, First Name, Last Name, Phone Number, Email, Nationality, Passport Number, Department, College, University, Address.

Passenger

Attributes: Passenger ID, First Name, Last Name, Phone Number, Email, Address, Nationality, Passport Number.

Airport

Attributes: Airport ID, Airport Name, City, Country.

Aircraft

Attributes: Aircraft ID, Aircraft Name, Aircraft Model, Capacity, Associated Airport (where it's based/parked).

Airline

Attributes: Airline ID, Airline Name, Country.

Flight

Attributes: Flight ID, Flight Number, Operating Airline, Starting Airport, Arrival Airport, Aircraft used, Starting Time, Arrival Time.

Booking

Attributes: Booking ID, Associated Passenger, Booked Flight, Booking Date, Seat Number, Booking Class.

Discount

Attributes: Discount ID, Applicable Student, Discount Percentage, Effective Date, Expiry Date.

CrewMember

Attributes: Crew ID, First Name, Last Name, Role (e.g., Pilot, Flight Attendant), Phone Number, Email.

CrewAssignment

Attributes: Assignment ID, Assigned Flight, Assigned Crew Member, Assignment Date.

Relationships

A Student may receive a Discount.

A Passenger makes Booking.

An Aircraft is based at an Airport.

An Airline operates Flight.

A Flight originates from an Airport and arrives at an Airport.

A Flight uses an Aircraft.

A Booking is for a Flight.

A CrewMember is assigned to a Flight (via CrewAssignment).

2.4 Logical Schema

```
Create database DBProject;
use DBProject;

create table Students (
StudentID varchar(50) PRIMARY KEY,
First_Name varchar(50) NOT NULL,
Last_Name varchar(50) NOT NULL,
Phone_Number varchar(15) NOT NULL,
Email varchar(100) NOT NULL,
Nationality varchar(50)  NOT NULL ,
Passport_number int (10) NOT NULL,
Department varchar(100) NOT NULL,
College varchar(30) NOT NULL,
University varchar(30) NOT NULL,
Address varchar(50) NOT NULL );
```

```
INSERT INTO Students (StudentID, First_Name, Last_Name, Phone_Number, Email,
Nationality,Passport_number, Department, College, University, Address)
Value ( "1381/16", "Gemachis", "Tesfaye", "+251976601074", "gemachistesfaye36@gmail.com",
"Ethiopian" , 1232, " Information Science", "CCI", "Haramaya", "Adaama"),
( "8109/16", "Fikru", "Hailu", "+251916033870", "fikruhailu65@gmail.com", "Ethiopian", 3248,
"Software Engineering", "CCI", "Haramaya", "Arbaminch"),
( "3678/15", "Daniel", "John", "+251956038671", "danjogn2024@gmail.com", "Kenyan", 4578 ,
"Economics", "FBE", "Haramaya", "Nairobi"),
( "0867/17", "Sisaay", "Tasew", "+251956038672", "sistasew398@gmail.com", "Ethiopian" ,
9675, "Statistics", "CCI", "Haramaya", "Bishoftu");

select* from Student;
```

StudentID	First_Name	Last_Name	Phone_Number	Email	Nationality	Passport_number	Department	College	University	Address
0867/17	Sisaay	Tasew	+251956038672	sistasew398@gmail.com	Ethiopian	9675	Statistics	CCI	Haramaya	Bishoftu
1381/16	Gemachis	Tesfaye	+251976601074	gemachistesfaye36@gmail.com	Ethiopian	1232	Information Science	CCI	Haramaya	Adaama
3678/15	Daniel	John	+251956038671	danjogn2024@gmail.com	Kenyan	4578	Economics	FBE	Haramaya	Nairobi
8109/16	Fikru	Hailu	+251916033870	fikruhailu65@gmail.com	Ethiopian	3248	Software Engineering	CCI	Haramaya	Arbaminch
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE Passenger (
    passengerID INT PRIMARY KEY,
    First_Name VARCHAR(50) NOT NULL,
    Last_Name VARCHAR(50) NOT NULL,
    Phone_Number VARCHAR(15) NOT NULL,
    Email VARCHAR(100) NOT NULL,
    Address VARCHAR(50) NOT NULL,
    Nationality VARCHAR(50) NOT NULL,
    Passport_number INT(10) NOT NULL
);

ALTER TABLE Passenger
ADD COLUMN StudentID VARCHAR(50);

ALTER TABLE Passenger
ADD CONSTRAINT FK_Passenger_Student FOREIGN KEY (StudentID) REFERENCES
Student(StudentID);

UPDATE Passenger
SET StudentID = "1381/16"
WHERE passengerID = 1;

UPDATE Passenger
SET StudentID = "8109/16"
WHERE passengerID = 2;
```

```
INSERT INTO Passenger (passengerID, First_Name, Last_Name, Phone_Number, Email,
Address, Nationality, Passport_number)
VALUES
   (1, "Samuel", "Tilahun", "+251976601075", "sammy67@gmail.com", "Bishoftu", "Ethiopian",
1223),
   (2, "Hawi", "Desalegn", "+251916033807", "hawwy76@gmail.com", "Dukem", "Ethiopian",
3284),
   (3, "Bonsa", "Horsa", "+251956038617", "boniboni@gmail.com", "Ambo", "Ethiopian", 4587),
   (4, "Yeabsira", "Getachew", "+25195603827", "nard90@gmail.com", "Jimma", "Ethiopian",
9657);
```

```
select* from Passenger;
```

passengerID	First_Name	Last_Name	Phone_Number	Email	Address	Nationality	Passport_number	StudentID
1	Samuel	Tilahun	+251976601075	sammy67@gmail.com	Bishoftu	Ethiopian	1223	1381/16
2	Hawi	Desalegn	+251916033807	hawwy76@gmail.com	Dukem	Ethiopian	3284	8109/16
3	Bonsa	Horsa	+251956038617	boniboni@gmail.com	Ambo	Ethiopian	4587	NULL
4	Yeabsira	Getachew	+25195603827	nard90@gmail.com	Jimma	Ethiopian	9657	NULL
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE Airport (
   AirportID INT PRIMARY KEY,
   Airport_name VARCHAR(100) NOT NULL,
   City VARCHAR(50) NOT NULL,
   Country VARCHAR(50) NOT NULL
);

INSERT INTO Airport (AirportID, Airport_name, City, Country)
VALUES
   (201, "Bole International Airport", "Addis Ababa", "Ethiopia"),
   (202, "Hawassa International Airport", "Hawassa", "Ethiopia"),
   (203, "BahirDar International Airport", "BahirDar", "Ethiopia"),
   (204, "Jimma International Airport", "Jimma", "Ethiopia"),
   (205, "Arbaminch International Airport", "Arbaminch", "Ethiopia"),
   (206, "Jomo Kenyata International Airport", "Nairobi", "Kenya");

INSERT INTO Airport VALUES (207, "Dirre Dawa International Airport", "DireDawa", "Ethiopia");
```

select* from Airport;

AirportID	Airport_name	City	Country
201	Bole International Airport	Addis Ababa	Ethiopia
202	Hawassa International Airport	Hawassa	Ethiopia
203	BahirDar International Airport	BahirDar	Ethiopia
204	Jimma International Airport	Jimma	Ethiopia
205	Arbaminch International Airport	Arbaminch	Ethiopia
206	Jomo Kenyata International Airport	Nairobi	Kenya
207	Dirre Dawa International Airport	DireDawa	Ethiopia
NULL	NULL	NULL	NULL

```
CREATE TABLE Aircraft (
    AircraftID VARCHAR(10) PRIMARY KEY,
    Aircraft_name VARCHAR(50) NOT NULL,
    Aircraft_model VARCHAR(50) NOT NULL,
    Capacity INT(10) NOT NULL,
    AirportID INT,
    FOREIGN KEY (AirportID) REFERENCES Airport(AirportID)
);

INSERT INTO Aircraft (AircraftID, Aircraft_name, Aircraft_model, Capacity, AirportID)
VALUES
    ("ET01", "Boeing", "737 MAX 8", 150, 201),
    ("ET02", "Boeing", "B787-9", 300, 202),
    ("ET03", "Boeing", "777-200LR", 300, 207),
    ("ET04", "Airbus", "A350-1000", 400, 207),
    ("ET05", "Boeing", "747-8", 400, 201),
    ("ET06", "Airbus", "A319-100", 125, 201),
    ("ET07", "Airbus", "A320neo", 180, 201),
    ("GR01", "Airbus", "A380", 500, 206),
    ("GR02", "Boeing", "737", 180, 206);
```

select* from Aircraft;

AircraftID	Aircraft_name	Aircraft_model	Capacity	AirportID
ET01	Boeing	737 MAX 8	150	201
ET02	Boeing	B787-9	300	202
ET03	Boeing	777-200LR	300	207
ET04	Airbus	A350-1000	400	207
ET05	Boeing	747-8	400	201
ET06	Airbus	A319-100	125	201
ET07	Airbus	A320neo	180	201
GR01	Airbus	A380	500	206
GR02	Boeing	737	180	206
NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE Airlines (
    AirlineID INT PRIMARY KEY,
    Airline_Name VARCHAR(100) NOT NULL,
```

```
    Country VARCHAR(50)
);
INSERT INTO Airlines (AirlineID, Airline_Name, Country) VALUES
(111, "Ethiopian Airlines", "Ethiopia"),
(112, "Kenya Airways", "Kenya"),
(113, "Lufthansa", "Germany"),
(114, "Emirates", "UAE");

select* from Airline;
```

AirlineID	Airline_Name	Country
111	Ethiopian Airlines	Ethiopia
112	Kenya Airways	Kenya
113	Lufthansa	Germany
114	Emirates	UAE
NULL	NULL	NULL

```
CREATE TABLE Flights (
    flightID INT PRIMARY KEY,
    flight_Number VARCHAR(10),
    airlineID INT,
    starting_airportID INT,
    arrival_airportID INT,
    aircraftID VARCHAR(10),
    starting_time TIME,
    arrival_time TIME,
    FOREIGN KEY (airlineID) REFERENCES Airlines(AirlineID),
    FOREIGN KEY (starting_airportID) REFERENCES Airport(AirportID),
    FOREIGN KEY (arrival_airportID) REFERENCES Airport(AirportID),
    FOREIGN KEY (aircraftID) REFERENCES Aircraft(AircraftID)
);

ALTER TABLE Flights
MODIFY COLUMN flight_Number VARCHAR(10) NOT NULL,
MODIFY COLUMN airlineID INT NOT NULL,
MODIFY COLUMN aircraftID VARCHAR(10) NOT NULL;

INSERT INTO Flights (flightID, flight_Number, airlineID, starting_airportID, arrival_airportID,
aircraftID, starting_time, arrival_time)
VALUES
    (51, "ET 706", 111, 201, 206, "ET01", "06:30:00", "17:30:00"),
    (52, "ET 707", 114, 206, 201, "GR01", "14:00:00", "17:30:00"),
    (53, "ET 607", 111, 201, 202, "ET02", "08:10:00", "09:15:00"),
    (54, "ET 607", 111, 201, 203, "ET02", "08:30:00", "09:40:00"),
    (55, "ET 607", 111, 202, 203, "ET01", "16:45:00", "13:20:00"),
```

```
    (56, "LH 4000", 114, 206, 204, "GR02", "14:30:00", "17:40:00"),
    (57, "AT 800", 114, 207, 205, "GR02", "14:00:00", "17:45:00"),
    (58, "ET 607", 113, 206, 201, "ET03", "01:00:00", "12:45:00"),
    (59, "ET 607", 111, 201, 205, "ET03", "02:15:00", "04:00:00");

select* from Flights;
```

flightID	flight_Number	airlineID	starting_airportID	arrival_airportID	aircraftID	starting_time	arrival_time
51	ET 706	111	201	206	ET01	06:30:00	17:30:00
52	ET 707	114	206	201	GR01	14:00:00	17:30:00
53	ET 607	111	201	202	ET02	08:10:00	09:15:00
54	ET 607	111	201	203	ET02	08:30:00	09:40:00
55	ET 607	111	202	203	ET01	16:45:00	13:20:00
56	LH 4000	114	206	204	GR02	14:30:00	17:40:00
57	AT 800	114	207	205	GR02	14:00:00	17:45:00
58	ET 607	113	206	201	ET03	01:00:00	12:45:00
59	ET 607	111	201	205	ET03	02:15:00	04:00:00
NULL	NULL	NULL	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE Bookings (
    BookingID INT PRIMARY KEY,
    passengerID INT NOT NULL,
    flightID INT NOT NULL,
    BookingDate DATETIME DEFAULT CURRENT_TIMESTAMP,
    SeatNumber VARCHAR(5) NOT NULL,
    BookingClass VARCHAR(50) NOT NULL,
    FOREIGN KEY (passengerID) REFERENCES Passenger(passengerID),
    FOREIGN KEY (flightID) REFERENCES Flights(flightID)
);

INSERT INTO Bookings (BookingID, passengerID, flightID, SeatNumber, BookingClass)
VALUES
    (25001, 1, 51, "7F", "First"),
    (25002, 2, 55, "12D", "Business"),
    (25003, 3, 52, "F30", "First"),
    (25004, 4, 51, "12B", "Economy"),
    (25005, 1, 53, "17F", "First"),
    (25006, 2, 51, "23F", "First");

select* from Bookings;
```

BookingID	passengerID	flightID	BookingDate	SeatNumber	BookingClass
25001	1	51	2025-06-10 16:55:16	7F	First
25002	2	55	2025-06-10 16:55:16	12D	Business
25003	3	52	2025-06-10 16:55:16	F30	First
25004	4	51	2025-06-10 16:55:16	12B	Economy
25005	1	53	2025-06-10 16:55:16	17F	First
25006	2	51	2025-06-10 16:55:16	23F	First
NULL	NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE Discount (
    DiscountID INT PRIMARY KEY AUTO_INCREMENT,
    StudentID VARCHAR(50) NOT NULL,
    DiscountPercentage DECIMAL(5,2) NOT NULL,
    EffectiveDate DATE NOT NULL,
    ExpiryDate DATE NOT NULL,
    FOREIGN KEY (StudentID) REFERENCES Students(StudentID)
);

INSERT INTO Discount (StudentID, DiscountPercentage, EffectiveDate, ExpiryDate) VALUES
("1381/16", 15.00, "2024-01-01", "2025-12-31"),
("8109/16", 10.00, "2024-03-15", "2025-03-14"),
("3678/15", 20.00, "2023-11-01", "2024-10-31");


select* from Discount;
```

DiscountID	StudentID	DiscountPercentage	EffectiveDate	ExpiryDate
1	1381/16	15.00	2024-01-01	2025-12-31
2	8109/16	10.00	2024-03-15	2025-03-14
3	3678/15	20.00	2023-11-01	2024-10-31
NULL	NULL	NULL	NULL	NULL

```
CREATE TABLE CrewMembers (
    CrewID INT PRIMARY KEY AUTO_INCREMENT,
    First_Name VARCHAR(50) NOT NULL,
    Last_Name VARCHAR(50) NOT NULL,
    Role VARCHAR(50) NOT NULL,
    Phone_Number VARCHAR(15),
    Email VARCHAR(100) UNIQUE
);

INSERT INTO CrewMembers (First_Name, Last_Name, Role, Phone_Number, Email) VALUES
("Aisha", "Ahmed", "Pilot", "+251911234567", "aisha.ahmed@example.com"),
("Bereket", "Tadesse", "Co-Pilot", "+251912345678", "bereket.tadesse@example.com"),
("Chaltu", "Kebede", "Flight Attendant", "+251913456789", "chaltu.kebede@example.com"),
("David", "Jones", "Flight Attendant", "+251914567890", "david.jones@example.com");
```

select* from CrewMembers;

CrewID	First_Name	Last_Name	Role	Phone_Number	Email
1	Aisha	Ahmed	Pilot	+251911234567	aisha.ahmed@example.com
2	Bereket	Tadesse	Co-Pilot	+251912345678	bereket.tadesse@example.com
3	Chaltu	Kebede	Flight Attendant	+251913456789	chaltu.kebede@example.com
4	David	Jones	Flight Attendant	+251914567890	david.jones@example.com
NULL	NULL	NULL	NULL	NULL	NULL

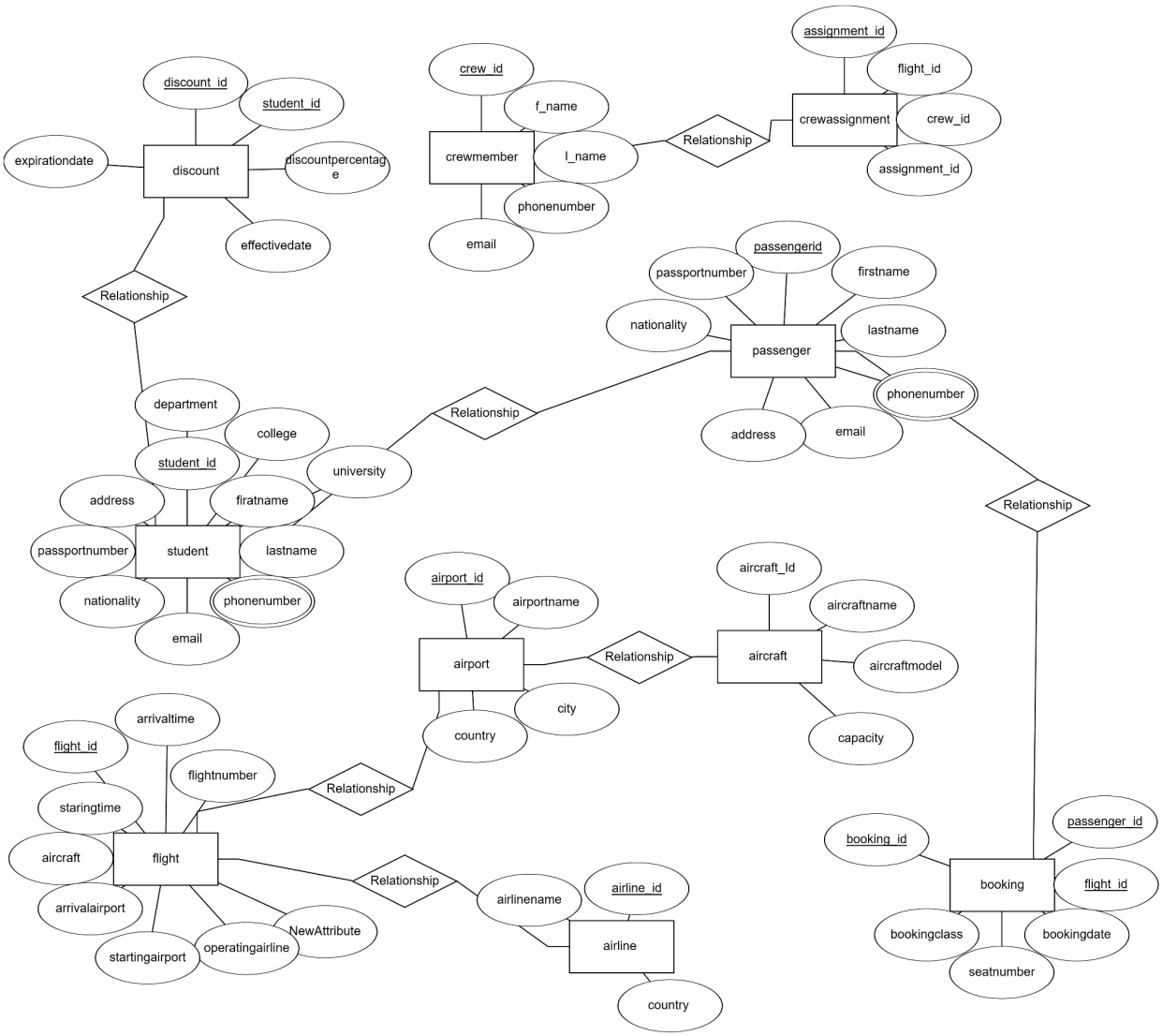
```
CREATE TABLE CrewAssignment (
    AssignmentID INT PRIMARY KEY AUTO_INCREMENT,
    FlightID INT NOT NULL,
    CrewID INT NOT NULL,
    AssignmentDate DATE NOT NULL,
    FOREIGN KEY (FlightID) REFERENCES Flights(FlightID),
    FOREIGN KEY (CrewID) REFERENCES CrewMembers(CrewID)
);

INSERT INTO CrewAssignment (FlightID, CrewID, AssignmentDate) VALUES
(51, 1, "2025-06-10"),
(51, 2, "2025-06-10"),
(51, 3, "2025-06-10"),
(53, 1, "2025-06-11"),
(53, 4, "2025-06-11"),
(55, 2, "2025-06-12");
```

select* from CrewAssignment;

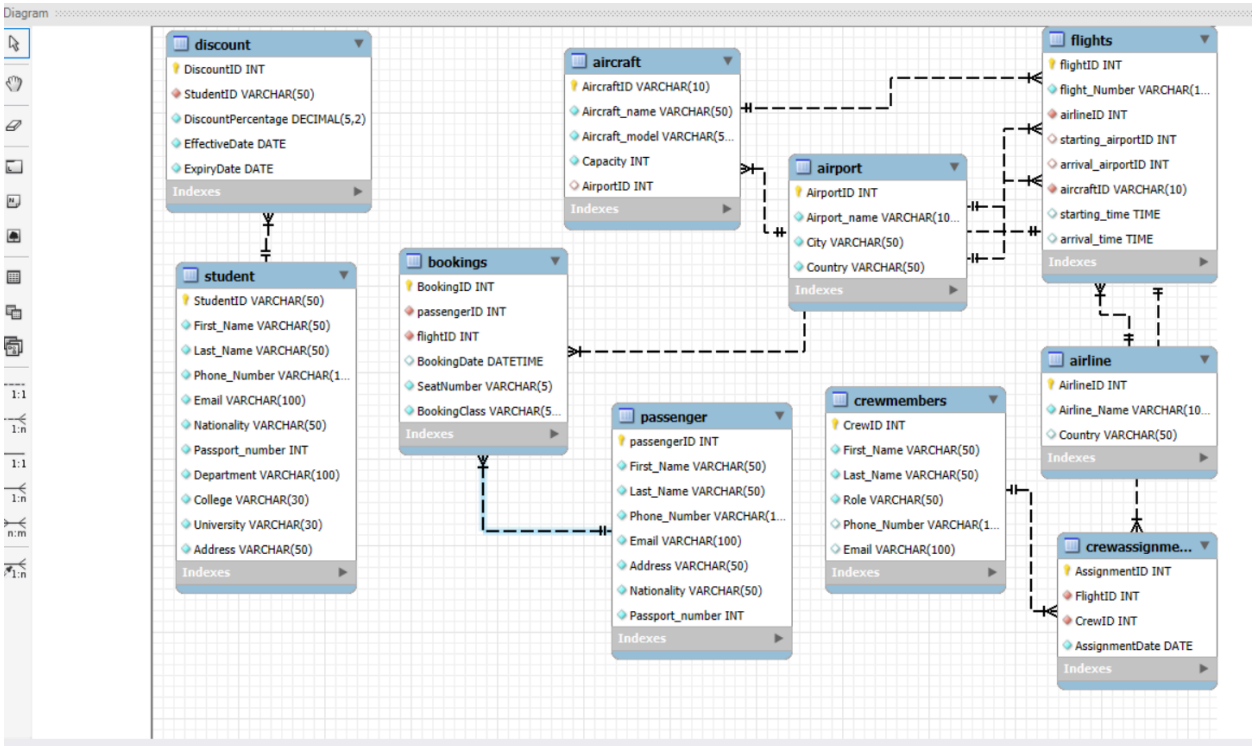
AssignmentID	FlightID	CrewID	AssignmentDate
1	51	1	2025-06-10
2	51	2	2025-06-10
3	51	3	2025-06-10
4	53	1	2025-06-11
5	53	4	2025-06-11
6	55	2	2025-06-12
NULL	NULL	NULL	NULL

2.5 Entity Relationship Diagram



https://erdplus.com/edit-diagram/50bb56c5-5d7a-42bd-b8a4-8ea19bc343df

2.6 Database Diagram



2.7 Normalization

1st Normal Form (1NF)

- Eliminate repeating groups.
- Each column contains atomic (indivisible) values.
- Each row is unique, identified by a primary key.

2nd Normal Form (2NF)

- Must be in 1NF.
- All non-key attributes are fully functionally dependent on the *entire* primary key. (No partial dependencies, especially for composite primary keys).

3rd Normal Form (3NF)

- Must be in 2NF.
- Eliminate transitive dependencies (non-key attributes should not depend on other non-key attributes).

Let see our tables Normalization. We just use it in written form as we haven't enough time to draw tables for all entities, which require much time and more effort. Due to an exam we are unable to do this.

1st Normal Form (1NF):

All of our tables, including **Students, Passenger, Airport, Aircraft, Airlines, Flights, Bookings, Discount, CrewMembers,** and **CrewAssignment,** are already in 1NF.

- Each column holds a single, atomic value (e.g., **First_Name** is just one name, not "Gemachis Tesfaye").
- There are no columns like **PhoneNumber1, PhoneNumber2** in our **Students** or **Passenger** tables. If a student had multiple phone numbers, we must put them in a separate **StudentPhoneNumbers** table, linked by **StudentID.**
- Every table has a PRIMARY KEY (**StudentID, passengerID, AirportID,** etc.) that uniquely identifies each record.

2nd Normal Form (2NF):

Most of our tables (**Students, Passenger, Airport, Aircraft, Airlines, Flights, Bookings, Discount, CrewMembers**) use a **single column as their primary key** (e.g., **StudentID, AircraftID, flightID)**. When the primary key isn't composite, you automatically satisfy 2NF!

For **CrewAssignment,** even though it links **FlightID** and **CrewID**, we used a separate **AssignmentID** as its primary key. This also avoids partial dependencies, making it 2NF compliant.

So, all your tables are in 2NF.

3rd Normal Form (3NF):

Let see them:

- **Aircraft** and **`Flights`:** We correctly separated **Aircraft_name, Aircraft_model**, and **Capacity** into the **Aircraft** table, where they directly depend on **AircraftID**. **Flights** only link to **Aircraft** via **`AircraftID`** avoiding the transitive dependency.

- **Airport** and **Flights:** Similarly, **Airport_name** , **City** and **Country** are in the **Airport** table, where they depend on **AirportID**. Flights correctly just store the **starting_airportID** and **arrival_airportID**.
- **Airlines and Flights: Airline_Name** and **Country** are correctly in the **Airlines** table, dependent on **AirlineID**.
- **Students :** For our **Students** table, **Department**, **College** and **University** are treated as direct attributes of the student record, not forming a chain where **Department** determines **College** *universally* across all universities in your system. Since we focus on Haramaya University students, this is acceptable and keeps the student data together logically.

Because we organized our tables this way, we removed these indirect dependencies. Each non-key column in our tables depends directly on its table's primary key.

Chapter 3

3.1 Recommendation

Based on the development and testing phases, several recommendations have emerged:

- **Future Scalability**

As domestic travel expands, consider expanding the system to support additional routes and possibly integrate a complementary mobile app.

- **Enhanced Reporting**

Incorporate advanced analytics to monitor booking trends and discount utilization patterns, which can inform marketing and operational strategies for Ethiopian Airlines.

- **Security Enhancements**

Continuously update the security protocols to guard against emerging threats, especially with regard to sensitive student and payment data.

- **Extended Integration**

Explore options to integrate with other academic institutions' databases, thereby expanding the discount benefit program and increasing market reach.

3.2 Conclusion

The Ethiopian Airlines domestic flights database project achieves its primary goal of streamlining flight scheduling, booking processing, and student discount application. By focusing exclusively on domestic operations and leveraging detailed database design strategies, the system offers a robust, efficient solution that benefits both the airline and its student clientele. The integrated online booking interface, combined with real-time verification of Haramaya University student status, creates a user-friendly environment that promotes ease-of-use and operational efficiency. The careful consideration of scalability, data integrity, and security ensures that the system can evolve alongside Ethiopia's growing domestic travel market.

3.3 References

1. **GeeksforGeeks.** *Database Normalization*. https://www.geeksforgeeks.org/normalisation-in-dbms/
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