**Project 1 Milestone Report 2**

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ACIS 5504: Information Systems Design and Database Concepts

October 15, 2024

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**Database Normalization**

**Picture:**

A close-up of a diagram

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**Explanation:**

The current database design is in third normal form (3NF) in the photo above. I reached this conclusion after a detailed normalization process that involved examining the relationships and attributes in the entities present in the ERD. I ensured that all functional dependencies were properly handled and that there were no transitive dependencies, which is a critical condition for achieving 3NF.

The process to bring the database to 3NF involved several key steps. First, I reviewed the data dictionary from Milestone 1 to identify all entities and their corresponding attributes. In this step, I focused on ensuring that all attributes were directly related to the primary key of the table they were placed in, adhering to the principles of first normal form (1NF) and second normal form (2NF). Specifically, in 1NF, I ensured that each table contains atomic values, with no repeating groups or arrays of values, and that each entity had unique rows and well-defined primary keys. For 2NF, I ensured that each non-primary key attribute was fully functionally dependent on the entire primary key. Fundamentally, this was particularly important in entities with composite primary keys, where attributes had to depend on the entire key, not just a subset.

To achieve this form, I worked to eliminate any transitive dependencies, ensuring that non-primary key attributes were dependent solely on the primary key and not on other non-key attributes. For example, in the Airline entity, attributes like aircraftType were directly related to the airline’s operations but did not create a transitive dependency with non-key attributes in other tables, such as Flight Details or Accident. This approach helped make sure that the relational model adhered to the principles of 3NF.

Using the tools in MIRO Board, I mapped out the entities and added relationships between them. Each relationship was verified to ensure it did not introduce transitive dependencies, confirming that the structure complied with 3NF. For instance, the Accident entity has clear relationships with other entities, such as Aircraft and Maintenance Record, ensuring that all attributes belong in their respective entities without indirect dependencies on non-key attributes in other tables. Additionally, I cross-referenced class materials to solidify my understanding of 3NF and used these guidelines to adjust the placement of attributes and relationships to reflect proper normalization. I also made some minor changes to the attribute types since some of the original designations were either meant to be something else, especially in regard to the information at hand such as aircraftType where I changed it to a string/varchar since often airplanes include letters followed by numbers. Did a complete verification of all relationships in 3NF diagram to ensure it accurately reflected the relationship between the entities properly. By following this process, the ERD now represents a database in third normal form, as demonstrated in the model.

**SQL DDL Code:**

**Code:**

CREATE DATABASE NTSB\_DB;

CREATE TABLE Accident (

c\_accidentID\_ac INT NOT NULL,

t\_location\_ac TEXT,

t\_description\_ac TEXT,

i\_severityLevel\_ac INT,

d\_date\_ac DATE,

c\_casualties\_pa INT,

c\_aircraftType\_ai VARCHAR(200),

c\_airlinename\_al TEXT,

c\_CaAccidentDesc\_acc TEXT,

c\_pilotID\_pi INT,

c\_passengersID\_pa INT,

c\_weatherconditionID\_wc INT,

c\_accidentcauseID\_acc INT,

c\_aircraftID\_ai INT,

c\_investigatorID\_in INT,

CONSTRAINT accident\_pk PRIMARY KEY (c\_accidentID\_ac),

CONSTRAINT fk\_pilot FOREIGN KEY (c\_pilotID\_pi) REFERENCES Pilot(c\_pilotID\_pi),

CONSTRAINT fk\_passenger FOREIGN KEY (c\_passengersID\_pa) REFERENCES Passenger(c\_passengersID\_pa),

CONSTRAINT fk\_weathercondition FOREIGN KEY (c\_weatherconditionID\_wc) REFERENCES Weather\_Conditions(c\_weatherconditionID\_wc),

CONSTRAINT fk\_accidentcause FOREIGN KEY (c\_accidentcauseID\_acc) REFERENCES Accident\_Cause(c\_accidentcauseID\_acc),

CONSTRAINT fk\_aircraft FOREIGN KEY (c\_aircraftID\_ai) REFERENCES Aircraft(c\_aircraftID\_ai),

CONSTRAINT fk\_investigator FOREIGN KEY (c\_investigatorID\_in) REFERENCES Investigator(c\_investigatorID\_in),

CONSTRAINT fk\_accidentcause2 FOREIGN KEY (c\_CaAccidentDesc\_acc) REFERENCES Accident\_Cause(t\_CaAccidentDesc\_acc),

CONSTRAINT fk\_airline FOREIGN KEY (c\_airlinename\_al) REFERENCES Airline(t\_airlinename\_al),

CONSTRAINT fk\_aircraft2 FOREIGN KEY (c\_aircraftType\_ai) REFERENCES Aircraft(t\_aircraftType\_ai),

CONSTRAINT fk\_passenger2 FOREIGN KEY (c\_casualties\_pa) REFERENCES Aircraft(i\_casualties\_pa)

);

CREATE TABLE Passenger (

c\_passengersID\_pa INT NOT NULL,

i\_Injured\_pa INT,

i\_casualties\_pa INT,

c\_accidentID\_ac INT NOT NULL,

CONSTRAINT passenger\_pk PRIMARY KEY (c\_passengersID\_pa),

CONSTRAINT fk\_accident2 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac)

);

CREATE TABLE Air\_Traffic\_Control (

c\_airtcID\_atc INT NOT NULL,

t\_controllerName\_atc TEXT,

t\_ATClocation\_atc TEXT,

i\_staffcount\_atc INT,

i\_controllerDuty\_atc TEXT,

c\_date\_ac DATE,

c\_pilotID\_pi INT,

c\_flightdetailsID\_fd INT,

CONSTRAINT airtrafficcontrol\_pk PRIMARY KEY (c\_airtcID\_atc),

CONSTRAINT fk\_pilot2 FOREIGN KEY (c\_pilotID\_pi) REFERENCES Pilot(c\_pilotID\_pi),

CONSTRAINT fk\_flightdetails FOREIGN KEY (c\_flightdetailsID\_fd) REFERENCES Flight\_Details(c\_flightdetailsID\_fd),

CONSTRAINT fk\_accident3 FOREIGN KEY (c\_date\_ac) REFERENCES Accident(d\_date\_ac)

);

CREATE TABLE Aircraft (

c\_aircraftID\_ai INT NOT NULL,

t\_manufacturer\_ai TEXT,

i\_yearacAircBuilt\_ai INT,

i\_numUnitsBuilt\_ai INT,

i\_yearsinProduction\_ai INT,

i\_numCrashes\_ai INT,

i\_totalFatalities\_ai INT,

t\_Tailidentification\_ai VARCHAR(200),

t\_aircraftType\_ai VARCHAR(200),

c\_airlineID\_al INT,

c\_accidentID\_ac INT,

c\_pilotID\_pi INT,

c\_maintenanceID\_ma INT,

CONSTRAINT aircraft\_pk PRIMARY KEY (c\_aircraftID\_ai),

CONSTRAINT fk\_airline4 FOREIGN KEY (c\_airlineID\_al) REFERENCES Airline(c\_airlineID\_al),

CONSTRAINT fk\_accident4 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac),

CONSTRAINT fk\_pilot3 FOREIGN KEY (c\_pilotID\_pi) REFERENCES Pilot(c\_pilotID\_pi),

CONSTRAINT fk\_maintenance FOREIGN KEY (c\_maintenanceID\_ma) REFERENCES Maintenance\_Record(c\_maintenanceID\_ma)

);

CREATE TABLE Pilot (

c\_pilotID\_pi INT NOT NULL,

t\_pilotName\_pi TEXT,

d\_dateofBirth\_pi DATE,

i\_experienceyears\_pi INT,

t\_medicalRecord\_pi TEXT,

i\_pilotFlightHoursinacair\_pi INT,

c\_TailidentificationNum\_ai VARCHAR(200),

c\_airtcID\_atc INT,

c\_accidentID\_ac INT,

c\_aircraftID\_ai INT,

CONSTRAINT pilot\_pk PRIMARY KEY (c\_pilotID\_pi),

CONSTRAINT fk\_aircraft5 FOREIGN KEY (c\_aircraftID\_ai) REFERENCES Aircraft(c\_aircraftID\_ai),

CONSTRAINT fk\_airtrafficcontrol FOREIGN KEY (c\_airtcID\_atc) REFERENCES Air\_Traffic\_Control(c\_airtcID\_atc),

CONSTRAINT fk\_accident6 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac),

CONSTRAINT fk\_aircraft6 FOREIGN KEY (c\_TailidentificationNum\_ai) REFERENCES Aircraft(t\_TailidentificationNum\_ai)

);

CREATE TABLE Safety\_Recommendation (

c\_safetyRecID\_sr INT NOT NULL,

t\_safetyRecDetails\_sr TEXT,

d\_dateIssued\_sr DATE,

c\_safetyimplementationID\_si INT,

c\_investigatorID\_in INT,

CONSTRAINT safetyrec\_pk PRIMARY KEY (c\_safetyRecID\_sr),

CONSTRAINT fk\_safetyimplementation FOREIGN KEY (c\_safetyimplementationID\_si) REFERENCES Safety\_Implementation(c\_safetyimplementationID\_si),

CONSTRAINT fk\_investigator3 FOREIGN KEY (c\_investigatorID\_in) REFERENCES Investigator(c\_investigatorID\_in)

);

CREATE TABLE Investigative\_Reports (

c\_reportID\_ir INT NOT NULL,

t\_reportTitle\_ir TEXT,

d\_publishDate\_i DATE,

t\_finalizedFindings\_ir TEXT,

t\_reportStatus\_ir TEXT,

c\_investigatorID\_in INT,

CONSTRAINT investigativereports\_pk PRIMARY KEY (c\_reportID\_ir),

CONSTRAINT fk\_investigator4 FOREIGN KEY (c\_investigatorID\_in) REFERENCES Investigator(c\_investigatorID\_in)

);

CREATE TABLE Investigator (

c\_investigatorID\_in INT NOT NULL,

t\_Investigatorname\_in TEXT,

t\_qualification\_in TEXT,

i\_yearsExperience\_in INT,

c\_accidentID\_ac INT,

c\_RiskAssessmentID\_ra INT,

c\_safetyRecID\_sr INT,

c\_reportID\_ir INT,

c\_accidentCauseID\_acc INT,

CONSTRAINT investigator\_pk PRIMARY KEY (c\_investigatorID\_in),

CONSTRAINT fk\_accident7 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac),

CONSTRAINT fk\_riskassessment FOREIGN KEY (c\_RiskAssessmentID\_ra) REFERENCES Risk\_Assessment(c\_RiskAssessmentID\_ra),

CONSTRAINT fk\_safetyrec FOREIGN KEY (c\_safetyRecID\_sr) REFERENCES Safety\_Recommendation(c\_safetyRecID\_sr),

CONSTRAINT fk\_report FOREIGN KEY (c\_reportID\_ir) REFERENCES Investigative\_Reports(c\_reportID\_ir),

CONSTRAINT fk\_accidentcause3 FOREIGN KEY (c\_accidentCauseID\_acc) REFERENCES Accident\_Cause(c\_accidentcauseID\_acc)

);

CREATE TABLE Accident\_Cause (

c\_accidentcauseID\_acc INT NOT NULL,

t\_CaAccidentDesc\_acc TEXT,

c\_accidentID\_ac INT,

c\_investigatorID\_in INT,

CONSTRAINT accidentcause\_pk PRIMARY KEY (c\_accidentcauseID\_acc),

CONSTRAINT fk\_accident9 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac),

CONSTRAINT fk\_investigator5 FOREIGN KEY (c\_investigatorID\_in) REFERENCES Investigator(c\_investigatorID\_in)

);

CREATE TABLE Safety\_Implementation (

c\_safetyimplementationID\_si INT NOT NULL,

t\_implementationDescription\_si TEXT,

d\_implementationDate\_si DATE,

t\_implementationStatus\_si TEXT,

c\_safetyRecID\_sr INT,

CONSTRAINT safetyimplementation\_pk PRIMARY KEY (c\_safetyimplementationID\_si),

CONSTRAINT fk\_safetyrec2 FOREIGN KEY (c\_safetyRecID\_sr) REFERENCES Safety\_Recommendation(c\_safetyRecID\_sr)

);

CREATE TABLE Weather\_Conditions (

c\_weatherconditionID\_wc INT NOT NULL,

t\_weatherDescription\_wc TEXT,

i\_visibility\_wc INT,

i\_windspeed\_wc INT,

t\_precipitationType\_wc TEXT,

i\_temperature\_wc INT,

c\_accidentID\_ac INT,

CONSTRAINT weatherconditions\_pk PRIMARY KEY (c\_weatherconditionID\_wc),

CONSTRAINT fk\_accident10 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac)

);

CREATE TABLE Risk\_Assessment (

c\_RiskAssessmentID\_ra INT NOT NULL,

i\_riskLevel\_ra INT,

t\_riskDescription\_ra TEXT,

c\_accidentID\_ac INT,

c\_investigatorID\_in INT,

CONSTRAINT riskassessment\_pk PRIMARY KEY (c\_RiskAssessmentID\_ra),

CONSTRAINT fk\_accident11 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac),

CONSTRAINT fk\_investigator6 FOREIGN KEY (c\_investigatorID\_in) REFERENCES Investigator(c\_investigatorID\_in)

);

CREATE TABLE Flight\_Details (

c\_flightdetailsID\_fd INT NOT NULL,

d\_flightdate\_fd DATE,

t\_flightnumber\_fd VARCHAR(200),

t\_flightOrigin\_fd TEXT,

t\_flightDestination\_fd TEXT,

c\_airtcID\_atc INT,

c\_airlineID\_al INT,

CONSTRAINT flightdetails\_pk PRIMARY KEY (c\_flightdetailsID\_fd),

CONSTRAINT fk\_airtrafficcontrol2 FOREIGN KEY (c\_airtcID\_atc) REFERENCES Air\_Traffic\_Control(c\_airtcID\_atc),

CONSTRAINT fk\_airline9 FOREIGN KEY (c\_airlineID\_al) REFERENCES Airline(c\_airlineID\_al)

);

CREATE TABLE Airline (

c\_airlineID\_al INT NOT NULL,

t\_airlinename\_al TEXT,

t\_country\_al TEXT,

i\_fleetSize\_al INT,

c\_accidentID\_ac INT,

c\_flightDetailsID\_fd INT,

c\_maintenanceID\_ma INT,

c\_aircraftID\_ai INT,

CONSTRAINT airline\_pk PRIMARY KEY (c\_airlineID\_al),

CONSTRAINT fk\_accident13 FOREIGN KEY (c\_accidentID\_ac) REFERENCES Accident(c\_accidentID\_ac),

CONSTRAINT fk\_flightdetails FOREIGN KEY (c\_flightDetailsID\_fd) REFERENCES Flight\_Details(c\_flightdetailsID\_fd),

CONSTRAINT fk\_maintenance FOREIGN KEY (c\_maintenanceID\_ma) REFERENCES Maintenance\_Record(c\_maintenanceID\_ma),

CONSTRAINT fk\_aircraft11 FOREIGN KEY (c\_aircraftID\_ai) REFERENCES Aircraft(c\_aircraftID\_ai)

);

CREATE TABLE Maintenance\_Record (

c\_maintenanceID\_ma INT NOT NULL,

d\_dateMa\_ma DATE,

t\_type\_ma TEXT,

t\_accCompletedWork\_ma TEXT,

b\_affectedAcc\_ma TINYINT(1),

c\_aircraftID\_ai INT,

c\_airlineID\_al INT,

CONSTRAINT maintenance\_pk PRIMARY KEY (c\_maintenanceID\_ma),

CONSTRAINT fk\_aircraft12 FOREIGN KEY (c\_aircraftID\_ai) REFERENCES Aircraft(c\_aircraftID\_ai),

CONSTRAINT fk\_airline14 FOREIGN KEY (c\_airlineID\_al) REFERENCES Airline(c\_airlineID\_al)

);

**DBMS Implementation**

* **Accident**

**A screenshot of a computer

Description automatically generated**

* **Airline**

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* **Investigator**

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* **Pilot**

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* **Maintenance\_Record**

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* **Investigative\_Reports**

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* **Flight\_Details**

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* **Aircraft**

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* **Passenger**

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* **Accident\_Cause**

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* **Air\_Traffic\_Control**

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* **Risk\_Assessment**

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* **Safety\_Implementation**

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* **Safety\_Recommendation:**

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* **Weather\_Conditions**

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