Milestone 2

1. Project Description

Our project is a Space Mission Tracker that helps users manage and track various aspects of space missions. It models entities such as missions, astronauts, agencies, spacecrafts, equipment, launch sites, training programs, mission logs and celestial bodies, and supports operations like assigning astronauts, logging mission details, tracking spacecraft used and overall tracking mission progress.

2. ER Diagram (attached on a separate page) Modifications (*green are attributes*, *red are entities* and *purple are relations*):

- Added attributes *model_name*, *crew_capacity* and *cargo_capacity_kg* to the *Spacecraft* entity to introduce additional non-PK/CK FDs.
- Removed *spacecraft_name* attribute from *Spacecraft* and moved it to *Mission* instead (spacecrafts can be reused - a mission can have a different name for each spacecraft).
- Added *agency_city* attribute to *Agency* and *site_city* to *LaunchSite* entities to introduce additional non-PK/CK FD.
- Corrected primary key/partial key notation per TA's feedback.
- Added *equipment_serial_num* attribute to *Equipment* and made it the primary key instead of *equipment_name* per TA's feedback.
- Modified relation *Uses* between *Mission* and *Spacecraft* from many-to-many to many-to-one and aggregated the relation to simplify design and make it more cohesive (since relation *LaunchedFrom* between *Mission* and *LaunchSite* is many-to-one). The reason for aggregation was to ensure that only a spacecraft in use by a mission needs to carry at least one equipment; spacecrafts not in use don't need to have this constraint. And, it makes more sense for spacecrafts to carry equipment if they are part of a mission.
- Modified names of the *type* attribute of all entities by appending entity name to it - making it more specific.
- Added descriptive attribute *launch_date* to the relation *LaunchedFrom* between *Mission* and *LaunchSite*.
- Added attribute *acronym* to *Agency* entity to allow for full names as well as acronyms of space agencies.

- Modified primary key of *TrainingProgram* from *program_name* to *program_name* and *location*.

3. Relational Schema

- CREATE TABLE Equipment
  (equipment_serial_num VARCHAR(30) PRIMARY KEY,
  equipment_name VARCHAR(100),
  eq_type VARCHAR(30))

- CREATE TABLE Spacecraft
  (spacecraft_id VARCHAR(30) PRIMARY KEY,
  model_name VARCHAR(50),
  manufacturer VARCHAR(30),
  sc_type VARCHAR(10),
  crew_capacity INTEGER,
  cargo_capacity_kg DECIMAL(8,2))
  *sc_types: cargo, crew, hybrid

- CREATE TABLE Carries
  (spacecraft_id VARCHAR(30),
  mission_id INTEGER,
  equipment_serial_num VARCHAR(30),
  PRIMARY KEY (spacecraft_id, mission_id, equipment_serial_num),
  FOREIGN KEY (spacecraft_id) REFERENCES Spacecraft,
  FOREIGN KEY (mission_id) REFERENCES Mission,
  FOREIGN KEY (equipment_serial_num) REFERENCES Equipment)
  *this table requires assertions since each spacecraft used by a mission must carry at least one piece of equipment

- CREATE TABLE Agency
  (agency_id INTEGER PRIMARY KEY,
  agency_name VARCHAR(100) UNIQUE NOT NULL,
  acronym VARCHAR(10) UNIQUE,
  agency_location VARCHAR(100),
  agency_city VARCHAR(30),
  agency_country VARCHAR(30))
  *all agencies must have names but may not have acronyms, agency_id self-assigned to avoid duplication (mismatch names)

- CREATE TABLE ParticipateIn
  (agency_id INTEGER,
  mission_id INTEGER,
  PRIMARY KEY (agency_id, mission_id),
  FOREIGN KEY (agency_id) REFERENCES Agency,
  FOREIGN KEY (mission_id) REFERENCES Mission)
  *this table requires assertions since each mission must have at least one agency

- CREATE TABLE Astronaut
  (astronaut_id INTEGER PRIMARY KEY,
  astronaut_name VARCHAR(50),
  nationality VARCHAR(5),
  dob DATE)
  *nationality = ISO country codes - usually 2-3 characters but max of 5 to be safe

- CREATE TABLE Pilot
  (astronaut_id INTEGER PRIMARY KEY,
  flight_hours DECIMAL(6,2),
  FOREIGN KEY (astronaut_id) REFERENCES Astronaut)

- CREATE TABLE Engineer
  (astronaut_id INTEGER PRIMARY KEY,
  speciality VARCHAR(30),
  FOREIGN KEY (astronaut_id) REFERENCES Astronaut)

- CREATE TABLE Researcher
  (astronaut_id INTEGER PRIMARY KEY,
  field VARCHAR(30),
  FOREIGN KEY (astronaut_id) REFERENCES Astronaut)

- CREATE TABLE AssignedTo
  (astronaut_id INTEGER,
  mission_id INTEGER,
  PRIMARY KEY (astronaut_id, mission_id),
  FOREIGN KEY (astronaut_id) REFERENCES Astronaut,
  FOREIGN KEY (mission_id) REFERENCES Mission)

- CREATE TABLE TrainingProgram
  (program_name VARCHAR(50),
  program_location VARCHAR(100),
  tp_type VARCHAR(50) NOT NULL,
  PRIMARY KEY (program_name, program_location))

- CREATE TABLE TrainedIn
  (astronaut_id INTEGER,
  program_name VARCHAR(50),
  program_location VARCHAR(100),
  PRIMARY KEY (astronaut_id, program_name, program_location),
  FOREIGN KEY (astronaut_id) REFERENCES Astronaut,
  FOREIGN KEY (program_name, program_location) REFERENCES TrainingProgram)
  *this table requires assertions since each Astronaut must have trained in a training program and each training program must have at least one Astronaut enrolment

4. **FDs**
5. **Normalized relations**
6. **SQL DDL CREATE + INSERT Statements**
7. **Populated Tables**