University of British Columbia, Vancouver
Department of Computer Science

CPSC 304 Project Cover Page

Milestone #: **2**

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Group Number: **55**

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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

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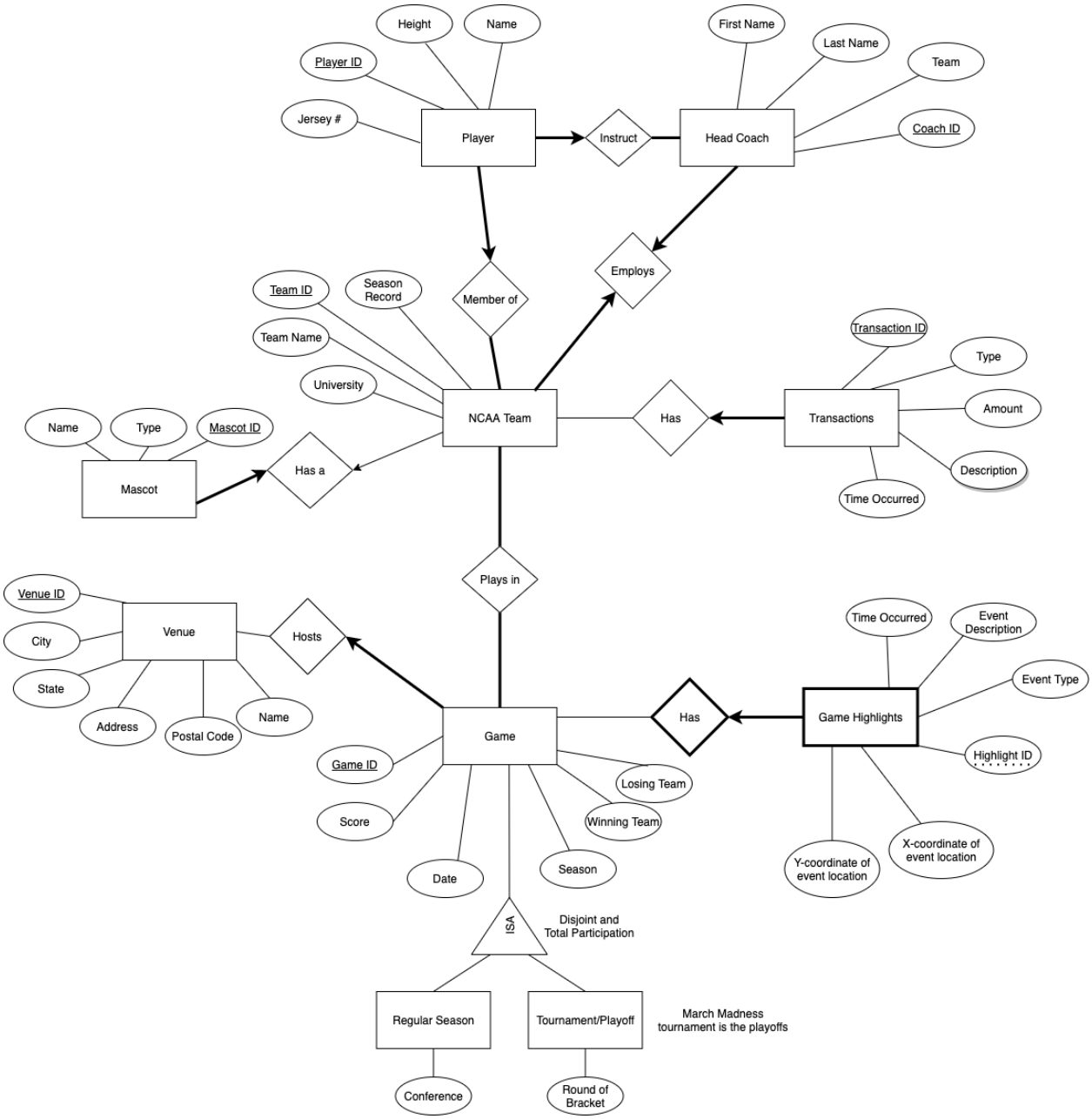
Task 2 – ER Diagram:

Please note the following revisions from the ER Diagram submitted in Milestone 1

- Added attribute postal code to the venues table
- Added attribute time occurred (transaction timestamp) in the transactions table
- Added attribute event description in the game highlights table
- Added a description of the ISA hierarchy to the diagram



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Task 3 – Translate ER Diagram to Relational Model:

Please note that primary keys are underlined and foreign keys are **bolded**.

1. Game (Game ID: Int, **Venue ID**: Int**,** Score: String, Date: Datetime, Season: String, Winning Team: String, Losing Team: String)
    - Candidate keys: (Date, Winning Team), (Date, Losing Team)

2. RegularSeasonGame (**Game ID: Int**, Conference: String)
    - Candidate keys: None

3. TournamentGame (**Game ID: Int**, Round of bracket: String)
    - Candidate keys: None

4. Venue (Venue ID: Int, City: String, State: String, Address: String, Postal Code: String, Name: String)
    - Candidate keys: None

5. PlaysIn (**Game ID: Int**, **Team ID: Int**)
    - Candidate keys: None

6. NCAATeam (Team ID: Int, Season record: String, Team Name: String, University: String)
    - Candidate keys: None

7. Player (Player ID: Int, **Team ID: Int**, **Coach ID: Int**, Jersey #: Int, Height: String, Name: String)
    - Candidate keys: (Team ID: Int, Jersey #: Int)

8. Transactions (Transaction ID: Int, **Team ID: Int,** Type: String, Time Occurred: Datetime, Amount: Float, Description: String)
    - Candidate keys: None

9. Mascot (Mascot ID: Int, **Team ID: Int**, Type: String, Name: String)
    - Candidate keys: None

10. HeadCoach (Coach ID: Int, **Team ID: Int**, First name: String, Last name: String)
    - Candidate keys: None

11. GameHighlights (Highlight ID: Int, **Game ID: Int**, TimeOccurred: Datetime, Event Type: String, Event Description: String, x_coord: Float, y_coord: Float)
    - Candidate keys: None

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Task 4 – Functional Dependencies:

1. Game FD's:
   a) GameID → Venue ID, Score, Date, Season, Winning Team, Losing Team
   b) Date, Winning Team → Game ID
   c) Date, Losing Team → Game ID
   d) Date → Season

2. RegularSeasonGame FD's:
   a) GameID → Conference

3. TournamentGame FD's:
   a) GameID → Round of bracket

4. Venue FD's:
   a) VenueID → City, State, Address, Postal Code, Name
   b) City, State, Address → Name
   c) City, Address → Name

5. Plays-In FD's:
   a) This is an intersection table so it has no functional dependencies

6. NCAA Team FD's:
   a) Team ID → Season Record, Team Name, University
   b) University → Team Name

7. Player FD's:
   a) Player ID → Name, Jersey Number, Height
   b) Team ID, Jersey Number → Player ID

8. Transactions FD's:
   a) Transaction ID → Type, Time Occurred, Amount, Description, Team ID

9. Mascot FD's:
   a) Mascot ID → Name, Type, Team ID

10. Head Coach FD's:
    a) Coach ID → First Name, Last Name, Team ID

11. Game Highlights FD's:
    a) Highlight ID, Game ID → Time Occurred, Event Type, Event Description, x_coord, y_coord

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Task 5 – Normalization:

1. **Game Normalization:**

   a) In the "Date → Season" dependency, Date is not a superkey and so we are in violation of both BCNF and 3NF. So, we decompose:
      i) Game1(Date, Season), Game2(GameID, Score, Date, Winning Team, Losing Team)

   b) Since GameID, [Date, Winning team], and [Date, Losing team] are all superkeys, no other decompositions are necessary.

   c) Game1(Date, Season):
      i) Primary key: Date
      ii) Candidate key: None
      iii) Foreign key: None
      iv) FD's: Date → Season

   d) Game2(GameID, Score, Date, Winning Team, Losing Team):
      i) Primary key: GameID
      ii) Candidate key: (Date, Winning Team), (Date, Losing Team)
      iii) Foreign key: None
      iv) FD's:
         (1) GameID → Venue ID, Score, Date, Season, Winning Team, Losing Team
         (2) Date, Winning Team → Game ID
         (3) Date, Losing Team → Game ID

2. **RegularSeasonGame Normalization:**
   All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same.

   a) GameID → Conference

3. **TournamentGame Normalization:**
   All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same.

   a) GameID → Round of bracket

4. **Venue Normalization:**

   a) Firstly, the functional dependencies are in violation of 2NF, as both (City, State, Address) and (City, Address) determine Name. Hence, we can eliminate City, State, Address → Name from our list of dependencies.

   b) New Venue FD's:
      i) VenueID → City, State, Address, Postal Code, Name
      ii) City, Address → Name

   c) After this is done, Venue must be decomposed, as (City, Address) isn't a candidate key.

   d) Venue1(VenueID, City, State, Address, Postal Code), Venue2(City, Address, Name)

e) Since VenueID is a superkey of Venue1 and (City, Address) is a superkey of Venue2, the tables are in BCNF and no further decomposition is required.

f) Venue1(VenueID, City, State, Address, Postal Code):
   i) Primary key: VenueID
   ii) Candidate key: None
   iii) Foreign key: None
   iv) FD's:
      (1) VenueID → City, State, Address, Postal Code, Name

g) Venue2(City, Address, Name)
   i) Primary key: (City, Address)
   ii) Candidate keys: None
   iii) Foreign keys: None
   iv) FD's:
      (1) City, Address → Name

5. "Plays In" Normalization:

No normalization needed. Primary key stayed the same.

6. NCAA Team Normalization:

a) University is not a superkey and one of our dependencies is University → Team Name. Hence, we are in violation of both BCNF and 3NF. So, we decompose:
   i) NCAA Team1(University, Name), NCAA Team2(Team ID, Season record, University)

b) Since Team ID is a superkey and all other functional dependencies are determined by Team ID, no other decompositions are needed.

c) NCAA Team1(University, Name):
   i) Primary key: University
   ii) Candidate keys: None
   iii) Foreign keys: None
   iv) FD's:
      (1) University → Team Name

d) NCAA Team2(Team ID, Season record, University)
   i) Primary key: Team ID
   ii) Candidate keys: None
   iii) Foreign keys: None
   iv) FD's:
      (1) Team ID → Season Record, University

7. Player Normalization:

All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same.

a) Player ID → Name, Jersey #, Height

b) Team ID, Jersey # → Player ID

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8. **Transactions Normalization:**
   All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same.

   a) Transaction ID → Type, Time Occurred, Amount, Description, Team ID

9. **Mascot Normalization:**
   All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same.

   a) Mascot ID → Name, Type, Team ID

10. **Head Coach Normalization:**
    All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same.

    a) Coach ID → First Name, Last Name, Team ID

11. **Game Highlights Normalization:**
    All LHS are super keys and therefore are in BCNF. Primary, Candidate, and Foreign keys stayed the same

    a) Highlight ID, Game ID → Time Occurred, Event Type, Event Description, x_coord, y_coord

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Task 6 – SQL DDL:

```
DROP DATABASE IF EXISTS ncaabaseketball;
CREATE DATABASE ncaabasketball;
SHOW CREATE DATABASE ncaabasketball;
USE ncaabasketball;

DROP TABLE IF EXISTS player;
DROP TABLE IF EXISTS headcoach;
DROP TABLE IF EXISTS ncaateam;
DROP TABLE IF EXISTS transactions;
DROP TABLE IF EXISTS mascot;
DROP TABLE IF EXISTS game;
DROP TABLE IF EXISTS reg_season_game;
DROP TABLE IF EXISTS tournament_game;
DROP TABLE IF EXISTS game_highlights;
DROP TABLE IF EXISTS venue;
--many to many relationship between games and teams in plays_in
DROP TABLE IF EXISTS plays_in;

CREATE TABLE player
  (
     player_id   INT,
     coach_id    INT,
     team_id     INT,
     player_name VARCHAR(200),
     height      VARCHAR(200),
     jersey_no   INT,
     PRIMARY KEY (player_id),
     FOREIGN KEY (coach_id) REFERENCES headcoach (coach_id),
     FOREIGN KEY (team_id) REFERENCES ncaateam (team_id)
  );

CREATE TABLE headcoach
  (
     coach_id   INT,
     first_name VARCHAR(200),
     last_name  VARCHAR(200),
     PRIMARY KEY (coach_id)
  );

CREATE TABLE ncaateam
  (
     team_id       INT,
     team_name     VARCHAR(200),
     university    VARCHAR(200),
     season_record VARCHAR(200),
     PRIMARY KEY (team_id)
  );
```

```
CREATE TABLE transactions
  (
     transaction_id        INT,
     team_id               INT,
     transaction_type      VARCHAR(200),
     amount                FLOAT,
     transaction_desc      VARCHAR(200),
     transaction_timestamp DATETIME,
     PRIMARY KEY (transaction_id),
     FOREIGN KEY (team_id) REFERENCES ncaateam (team_id)
  );

CREATE TABLE mascot
  (
     mascot_id   INT,
     team_id     INT,
     mascot_name VARCHAR(200),
     mascot_type VARCHAR(200),
     PRIMARY KEY (mascot_id),
     FOREIGN KEY (team_id) REFERENCES ncaateam (team_id) ON DELETE CASCADE
  );

CREATE TABLE game
  (
     game_id      INT,
     venue_id     INT,
     score        VARCHAR(200),
     game_date    DATETIME,
     season       VARCHAR(200),
     winning_team VARCHAR(200),
     losing_team  VARCHAR(200),
     PRIMARY KEY (game_id),
     FOREIGN KEY (venue_id) REFERENCES venue (venue_id)
  );

CREATE TABLE reg_season_game
  (
     game_id    INT,
     conference VARCHAR(200),
     PRIMARY KEY (game_id),
     FOREIGN KEY (game_id) REFERENCES game (game_id) ON DELETE CASCADE
  );

CREATE TABLE tournament_game
  (
     game_id          INT,
     round_of_bracket VARCHAR(200),
     PRIMARY KEY (game_id),
     FOREIGN KEY (game_id) REFERENCES game (game_id) ON DELETE CASCADE
  );
```

```
CREATE TABLE game_highlights
  (
     highlight_id        INT,
     game_id             INT,
     event_type          VARCHAR(200),
     event_desc          VARCHAR(200),
     highlight_timestamp DATETIME,
     --The location of the play in inches from the "left" baseline, max 1128
     x_coord             FLOAT,
     --The location of the play in inches from the "top" sideline, max 600
     y_coord             FLOAT,
     PRIMARY KEY (game_id, highlight_id),
     FOREIGN KEY (game_id) REFERENCES game (game_id) ON DELETE CASCADE
  );

CREATE TABLE venue
  (
     venue_id        INT,
     venue_city      VARCHAR(200),
     venue_state     VARCHAR(200),
     venue_postal_cd VARCHAR(200),
     venue_address   VARCHAR(200),
     venue_name      VARCHAR(200),
     PRIMARY KEY (venue_id)
  );

CREATE TABLE plays_in
  (
     game_id INT,
     team_id INT,
     PRIMARY KEY (game_id, team_id),
     FOREIGN KEY (game_id) REFERENCES game (game_id),
     FOREIGN KEY (team_id) REFERENCES team (game_id)
  );
```

Task 7 – Populate tables with tuples:

```sql
--Player table
INSERT INTO player
  (player_id, coach_id, team_id, player_name, height, jersey_no)
VALUES
  (1, 1, 1, 'Cassius Winston', '6-1', 5),
  (2, 1, 1, 'Nick Ward', '6-9', 44),
  (3, 2, 2, 'R.J. Barrett', '6-7', 5),
  (4, 2, 2, 'Cam Reddish', '6-8', 2),
  (5, 3, 3, 'Tremont Waters', '5-11', 3);

--Headcoach table
INSERT INTO headcoach
  (coach_id, first_name, last_name)
VALUES
  (1, 'Tom', 'Izzo'),
  (2, 'Mike', 'Krzyzewski'),
  (3, 'Will', 'Wade'),
  (4, 'Richard', 'Pitino'),
  (5, 'Ritchie', 'McKay');

--Headcoach table
INSERT INTO ncaateam
  (team_id, team_name, university, season_record)
VALUES
  (1, 'Spartans', 'Michigan State University', '28-6'),
  (2, 'Blue Devils', 'Duke University', '29-5'),
  (3, 'Tigers', 'Louisiana State University', '26-6'),
  (4, 'Golden Gophers', 'Minnesota State University', '21-13'),
  (5, 'Flames', 'Liberty University', '28-6');

--Transactions table
INSERT INTO transactions
  (transaction_id, team_id, transaction_type, amount, transaction_desc, transaction_timestamp)
VALUES
  (1, 5, 'Revenue', 500000.00, 'Merchandise sales for Mar 2018', '2018-04-01 02:14:00'),
  (2, 3, 'Expense', -65000.00, 'Penalty for failing to adhere to safety protocols', '2018-04-03 12:33:14'),
  (3, 1, 'Revenue', 100000.00, 'Ad sponsorship from athletics gear brand', '2018-04-15 21:03:02'),
  (4, 1, 'Revenue', 22816.35, 'Brand endorsement income for Apr 2018', '2018-04-22 10:49:00'),
  (5, 2, 'Expense', -38000.01, 'Celebration party expense', '2018-05-09 11:52:44');

--Mascot table
INSERT INTO mascot
  (mascot_id, team_id, mascot_name, mascot_species)
VALUES
  (1, 3, 'Live Tiger', 'Tigiris'),
  (2, 2, 'Devil', NULL),
  (3, 4, 'Goldy', NULL),
  (4, 5, 'Sparky', 'Eagle'),
  (5, 1, 'Sparty', 'Sapiens');

--Game table
INSERT INTO game
  (game_id, venue_id, score, game_date, season, winning_team, losing_team)
VALUES
  (1, 1, '83-78', '2018-01-09 12:00:00', '2018', 'Spartans', 'Flames'),
  (2, 3, '103-102', '2018-01-20 15:00:00', '2018', 'Spartans','Tigers'),
  (3, 5, '111-107', '2018-01-24 17:30:00', '2018', 'Flames', 'Golden Gophers'),
  (4, 1, '99-87', '2018-02-03 18:45:00', '2018', 'Blue Devils', 'Spartans'),
  (5, 4, '82-80', '2018-02-21 20:00:00', '2018', 'Golden Gophers', 'Tigers'),
  (6, 2, '82-69', '2018-02-26 11:30:00', '2018', 'Blue Devils', 'Golden Gophers'),
  (7, 5, '108-103', '2018-02-28 13:15:00', '2018', 'Tigers', 'Flames'),
  (8, 3, '76-70', '2018-03-03 14:45:00', '2018', 'Spartans', 'Tigers'),
  (9, 2, '92-81', '2018-03-08 18:10:00', '2018', 'Blue Devils', 'Tigers'),
  (10, 1, '100-97', '2018-03-15 19:45:00', '2018', 'Spartans', 'Blue Devils');
```

```sql
--Regular Season Game table
INSERT INTO reg_season_game
  (game_id, conference)
VALUES
  (1, 'Southeastern'),
  (2, 'Big Ten'),
  (3, 'Atlantic Coast'),
  (4, 'Patriot Leauge'),
  (5, 'Mideastern');

--Tournament Game table
INSERT INTO tournament_game
  (game_id, round_of_bracket)
VALUES
  (6, 'First Round'),
  (7, 'Second Round'),
  (8, 'Quarterfinal 4'),
  (9, 'Semifinal 1'),
  (10, 'Semifinal 2');

--Game Highlights table
INSERT INTO game_highlights
  (highlight_id, game_id, event_type, event_desc, highlight_timestamp, x_coord, y_coord)
VALUES
  (1, 1, 'twopointmade', 'Nick Ward makes two point shot', '2018-01-09 22:52:46', 89.0, 297.0),
  (2, 1, 'rebound', 'Scottie James offensive rebound', '2018-01-09 22:55:48', 364.0, 291.0),
  (3, 1, 'shootingfoul', 'Jim Walter shooting foul', '2018-01-09 22:58:17', 1048.0, 324.0),
  (4, 1, 'turnover', 'Justin Jones turnover (bad pass)', '2018-01-09 23:20:20', 370.0, 202.0),
  (5, 1, 'end_period', 'End of 2nd half', '2018-01-09 23:23:05', NULL, NULL),
  (6, 2, 'opentip', 'Riley Grabau vs. Larry Nance Jr', '2018-01-20 00:02:39', 574.0, 290.0),
  (7, 2, 'twopointmiss', 'Nic Moore misses two point jump shot', '2018-01-20 00:03:37', 870.0, 246.0),
  (8, 2, 'turnover', 'Ben Moore turnover (bad pass) (Josh Adams steals)', '2018-01-20 00:04:55', 911.0, 591.0),
  (9, 2, 'assist', 'Ryan Manuel makes two point layup', '2018-01-20 00:06:43', 1028.0, 277.0),
  (10, 2, 'officialtimeout', 'Official timeout', '2018-01-20 03:57:00', NULL, NULL);

--Venue table
INSERT INTO venue
  (venue_id, venue_city, venue_postal_cd, venue_state, venue_address, venue_name)
VALUES
  (1, 'East Lansing', '48824', 'MI', 'One Birch Road', 'Jack Breslin Students Events Center'),
  (2, 'Durham', '27706', 'NC', '301 Whitford Drive', 'Cameron Indoor Stadium'),
  (3, 'Baton Rouge', '70803', 'LA', 'North Stadium Road', 'Pete Maravich Assembly Center'),
  (4, 'Minneapolis', '55455', 'MN', '1925 SE University Avenue', 'Williams Arena'),
  (5, 'Lynchburg', '24502', 'VA', '1971 University Blvd', 'Vines Center');

--Plays-In table
INSERT INTO plays_in
  (game_id, team_id)
VALUES
  (1, 1),
  (1, 5),
  (2, 1),
  (2, 3),
  (3, 5),
  (3, 4),
  (4, 2),
  (4, 1),
  (5, 4),
  (5, 3);
```

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Task 8 – List queries in plain English

1. Insertion:
    - Add a new player to the NCAA basketball players table

2. Deletion:
    - Remove all games from seasons that are 10 years or older in the games table

3. Update:
    - Replace an old head coach with a new one in the head coach table

4. Selection:
    - Select all information from the venues table where the location of the venue are in the following states – North Carolina, Michigan, Texas

5. Projection:
    - Project only the team names where the team has a season record win-rate of over 70%

6. Join
    - Get the total costs from a NCAA basketball team (eg: Michigan State) where the transaction type is an "expense"
    - Note: This involves a natural join between the teams table and the transactions table, and then aggregating that amount to get the total cost

7. Division
    - Find the list of NCAA teams that have played in every single round-of-bracket of tournament games