

## Explanation

The Manager table has Manager\_ID, First\_Name, Last\_Name, and Age, where **Manager\_ID** is the **Primary Key**. Each manager is linked to only one team. The Team table has Team\_ID, Team\_Name, Team\_Abbreviation, Manager\_ID, and Year\_Founded, where **Team\_ID** is the **Primary Key** and **Manager\_ID** is the **Foreign Key** referencing to the Manager table. Each team may have multiple players. The Player table has Player\_ID, First\_Name, Last\_Name, Team\_ID, Age, and Shirt\_Number, where **Player\_ID** is the **Primary Key** and **Team\_ID** is the **Foreign Key** referencing the Team table. Total participation means every team has one manager, and every player is associated with one team. Referential integrity is enforced by Manager\_ID and Team\_ID foreign keys.

## Normalisation

All three tables are in BCNF, since each non-key attribute is functionally dependent on the primary key of the table it is contained in. No non-prime attributes are dependent on any part of the table except the candidate keys, and there are no transitive dependencies.

# DDL Statements

```
CREATE TABLE IF NOT EXISTS Manager (  
    Manager_ID INTEGER NOT NULL,  
    First_Name VARCHAR(50),  
    Last_Name VARCHAR(50),  
    Age INTEGER,  
    PRIMARY KEY (Manager_ID)  
);
```

```
CREATE TABLE IF NOT EXISTS Team (  
    Team_ID INTEGER NOT NULL,  
    Team_Name VARCHAR(100),  
    Team_Abbreviation VARCHAR(5),  
    Manager_ID INTEGER NOT NULL UNIQUE,  
    Year_Founded INTEGER,  
    PRIMARY KEY (Team_ID),  
    FOREIGN KEY (Manager_ID) REFERENCES UNIQUE Manager(Manager_ID)  
);
```

```
CREATE TABLE IF NOT EXISTS Player (  
    Player_ID INTEGER NOT NULL,  
    First_Name VARCHAR(50),  
    Last_Name VARCHAR(50),  
    Team_ID INTEGER NOT NULL,  
    Age INTEGER,  
    Shirt_Number INTEGER,  
    PRIMARY KEY (Player_ID),  
    FOREIGN KEY (Team_ID) REFERENCES Team(Team_ID)  
);
```

# Relational Algebra Formulations

## Deletions

$\text{Manager} \leftarrow \text{Manager} - \sigma_{\text{Manager\_ID} = 1}(\text{Manager})$

$\text{Team} \leftarrow \text{Team} - \sigma_{\text{Team\_ID} = 1}(\text{Team})$

*These will both be rejected since the Manager table and Team table has a foreign key in the Team tables and Player table respectively.*

## Group By

$\pi_{\text{First\_Name}, \text{Last\_Name}, \text{Shirt\_Number}}(\sigma_{\text{Team\_ID} = 1 \wedge \text{Shirt\_Number} < 10}(\text{Player}))$

$\pi_{\text{First\_Name}, \text{Last\_Name}, \text{Age}}(\sigma_{\text{Age} > 50}(\text{Manager}))$

# DML Statements

## Deletions

DELETE FROM Manager

WHERE Manager\_ID = 1;

DELETE FROM Team

WHERE Team\_ID = 1;

## Group By

SELECT First\_Name, Last\_Name, Shirt\_Number  
FROM Player WHERE Team\_ID = 1 AND Shirt\_Number < 10  
GROUP BY First\_Name, Last\_Name, Shirt\_Number;

SELECT First\_Name, Last\_Name, Age  
FROM Manager WHERE Age > 50  
GROUP BY First\_Name, Last\_Name, Age