1 ER Diagrams

We want to store sports teams and their players in our database. Draw an ER diagram corresponding to data given below:

- Every Team in our database will have a unique team_name and a stadium where they play their games.
- Each Coach has a name.
- Each Player will have a player_id, name and their average score.
- Our database will contain who Plays_For which team and also the “position” that the player plays in. We also need to store who Captains a team, and who Coaches a team.
- Every Team needs players, and needs exactly one captain.
- Each Player can be on at most one team, but may currently be a free agent and not on any team.
- Each team needs coaches and may have many.
- A Coach is uniquely identified by which team they coach.
2 Functional Dependencies

1. When there’s a lot of symbols floating around, it’s best to keep track of the "type" of the various symbols and expressions. Consider a set of functional dependencies $F = \{X \rightarrow Y, Y \rightarrow Z\}$. For each of the following symbols or expressions, indicate whether it is (a) an attribute, (b) a set of attributes, (c) a set of sets of attributes, (d) a functional dependency, (e) a set of functional dependencies, or (f) none of the above.

(a) $X$
(b) $XY$
(c) $X \rightarrow Y$
(d) $F$
(e) $F^+$
(f) $X^+$
(g) Armstrong’s reflexivity axiom

2. Consider a relation $R(x, y, z)$ and the list of functional dependencies $X \rightarrow Y$, $XY \rightarrow YZ$, and $Y \rightarrow X$ where $X = \{x\}$, $Y = \{y\}$, and $Z = \{z\}$. For each of the following relations, indicate which functional dependencies it might satisfy.

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3. Consider the set $F = \{A \rightarrow B, AB \rightarrow AC, BC \rightarrow BD, DA \rightarrow C\}$ of functional dependencies. Compute the following attribute closures.

(a) $A^+$
(b) $B^+, C^+, D^+$
(c) $AB^+, AC^+, AD^+$
(d) $BC^+$
(e) $BD^+$
(f) $CD^+$
(g) $BCD^+$
4. Consider again the set $F$ of functional dependencies from Question 3. Indicate whether the following sets of attributes are candidate keys, superkeys (but not candidate keys), or neither.

(a) A 
(b) B, C, D 
(c) AB, AC, AD 
(d) BC 
(e) BD 
(f) CD 
(g) BCD 

3 Normal Forms

1. Decompose $R = ABCDEFG$ into BCNF, given the functional dependency set: $F = AB \rightarrow CD$, $C \rightarrow EF$, $G \rightarrow A$, $G \rightarrow F$, $CE \rightarrow F$.

2. Does the above decomposition preserve dependencies? Why/why not?