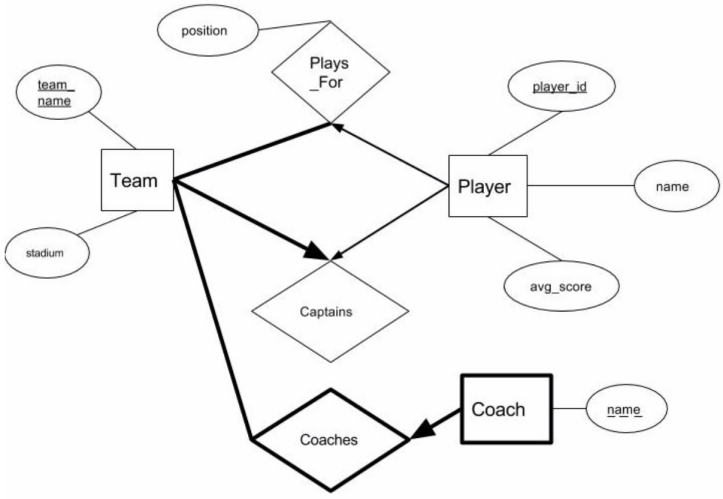
CS W186 Introduction to Database Systems
Spring 2020 Josh Hug, Michael Ball

DIS 10

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 -> Y, Y -> 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) a set of attributes

   (b) XY (b) a set of attributes

   (c) X -> Y (d) a functional dependency

   (d) F (e) a set of functional dependencies

   (e) F+ (e) a set of functional dependencies

   (f) X+ (b) a set of attributes

   (g) Armstrong's reflexivity axiom (f) an axiom

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

x	y	z
1	2	0
1	2	1
1	3	0
2	3	0

x	y	z
1	2	1
1	3	1
2	3	0

x	y	z
1	3	1
2	3	0

x	y	z
1	3	1

   1. None
   2. XY -> YZ
   3. X -> Y, XY -> YZ
   4. X -> Y, XY -> YZ, Y -> X

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

   (a) A+ ABCD

   (b) B+, C+, D+ B, C, D; B, C, and D do not appear alone on the left of any functional dependency, so nothing is in their attribute closures besides themselves.

   (c) AB+, AC+, AD+ ABCD; A+ = ABCD, so AX = ABCD for any X.

(d) BC+ BCD

(e) BD+ BD

(f) CD+ CD

(g) BCD+ 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 candidate key

   (b) B, C, D neither

   (c) AB, AC, AD superkey

   (d) BC neither

   (e) BD neither

   (f) CD neither

   (g) BCD neither

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.

   AB$\rightarrow$CD => decompose ABCDEFG into ABCD, ABEFG
   G$\rightarrow$A => decompose ABEFG into AG, BEFG
   G$\rightarrow$F => decompose BEFG into FG, BEG
   Final relations: ABCD, AG, FG, BEG.

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

   No, C $\rightarrow$ EF and CE $\rightarrow$ F are not represented in the closure of the union of each subrelation's dependencies.s