

CSE 344 Section 5 Worksheet

1. Consider the following database schema for a restaurant.

Ingredient(iid, name, allergen)

Dish(did, name, description, category)

IngredientIn(iid, did)

Order(oid, customer)

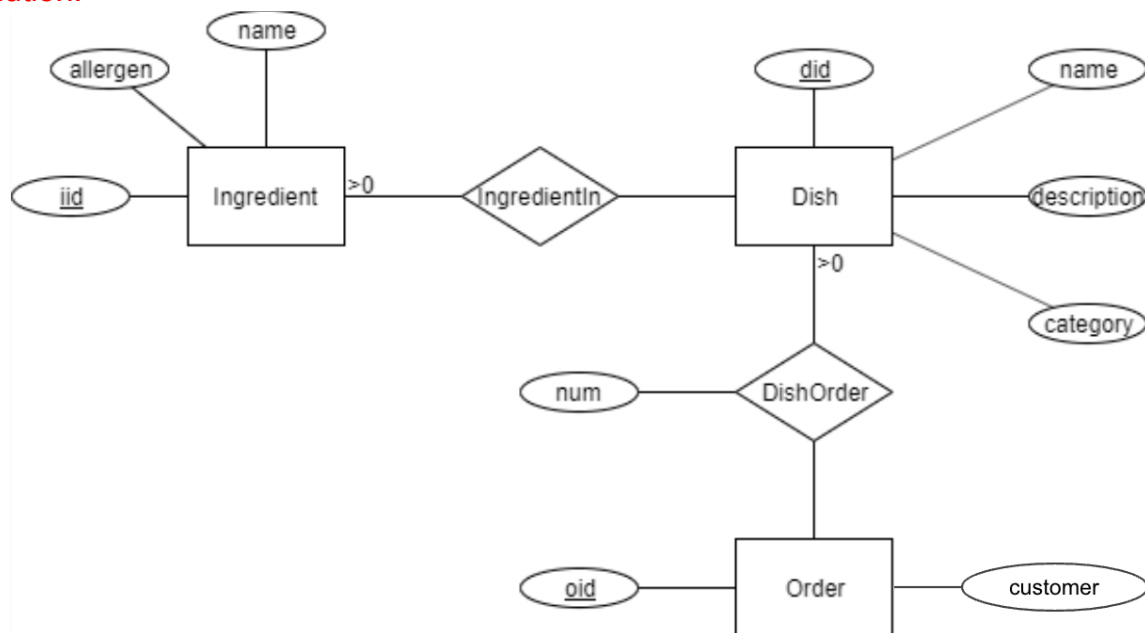
DishOrder(oid, did, num)

Draw an E/R diagram to represent the database, with the Ingredient, Dish, and Order tables as the entities, and IngredientIn and DishOrder as the relationships.

Make sure to enforce the following constraints:

- Ingredient.iid, Dish.did, Order.oid are the primary keys of the respective tables
- A Dish should have **at least one** Ingredient.
- An Order should have **at least one** Dish.

Solution:

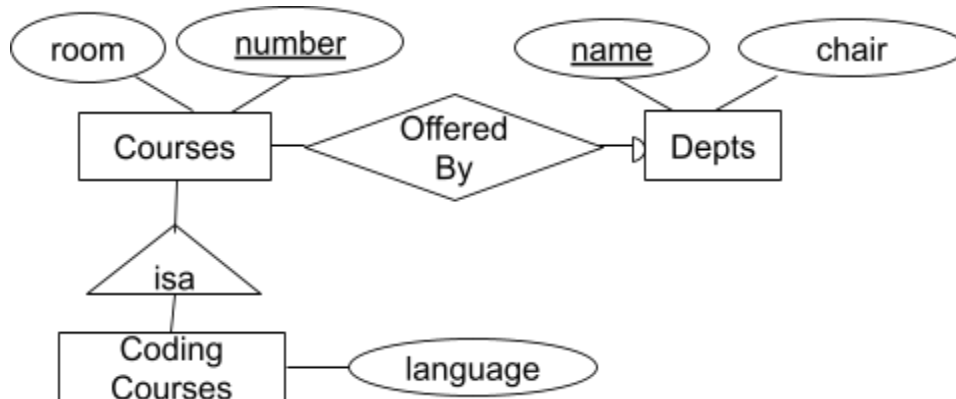


2. Convert the E/R diagram below to relations in BCNF form. Assume no values are NULL, and the arrow between OfferedBy and Depts is a round one. Include all keys and foreign keys. Use the following notation and explicitly state foreign key relationships.

For instance:

$R(\underline{a}, b)$

$S(\underline{c}, d)$ -- c is a foreign key to R



$Courses(\underline{number}, room, name)$ -- $name$ is foreign key to Depts

$CodingCourses(language, \underline{number})$ -- $number$ is foreign key to Courses

$Depts(\underline{name}, chair)$

3. Given $R(A, B, C, D, E)$, and functional dependencies: $A \rightarrow B$, $BC \rightarrow E$, $DE \rightarrow A$.

a. Find minimal key(s) for R .

Minimal key: BCD or ACD or CDE

b. Is ACDE a super key?

ACDE is a superkey because it determines all attributes. (We can easily deduce this because one of the minimal keys is a subset.)

c. Is CDE a super key?

CDE is a superkey because it is also a minimal key, and all minimal keys are superkeys

4. Given $R(A, B, C, D, E, F)$ and FDs: $B \rightarrow A$, $E \rightarrow B$, $D \rightarrow C$, $A \rightarrow C$

Decompose R into BCNF. In each step, explain which functional dependency you used to decompose and explain why further decomposition is needed. Your answer should consist of a list of table names and attributes. Make sure you indicate the keys for each relation.

1. Use $B \rightarrow A$, $A \rightarrow C$

Decompose R into $R_1(B, A, C)$ and $R_2(B, D, E, F)$

R_1 violates $A \rightarrow C$, so we need to further decompose R_1

R_2 violates $E \rightarrow B$, so we need to further decompose R_2

2. Use $A \rightarrow C$

Decompose R_1 into $R_{11}(A, C)$ and $R_{12}(A, B)$

3. Use $E \rightarrow B$

Decompose R_2 into $R_{21}(E, B)$ and $R_{22}(E, D, F)$

Final Decompositions: $R_{11}(A, \underline{C})$, $R_{12}(\underline{A}, B)$, $R_{21}(\underline{E}, B)$, $R_{22}(E, D, F)$

5. **(17WI Final Q4)** Given $R(A, B, C, D, E)$, and FDs: $A \rightarrow C$, $BD \rightarrow A$, $D \rightarrow E$

Decompose R into BCNF. In each step, explain which functional dependency you used to decompose and explain why further decomposition is needed. Your answer should consist of a list of table names and attributes. Make sure you indicate the keys for each relation.

One possible decomposition:

1. Use $A \rightarrow C$:

Decompose R into $R_1(A, C)$ and $T(A, B, D, E)$

T violates $BD \rightarrow A$ and $D \rightarrow E$, so we need to further decompose T

2. Use $D \rightarrow E$:

Decompose T into $R_2(B, D, A)$ and $R_3(D, E)$

Final relations: $R_1(\underline{A}, C)$, $R_2(\underline{B}, \underline{D}, A)$, and $R_3(\underline{D}, E)$