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Database Design

6-2

Normalization and First Normal Form

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Objectives

- This lesson covers the following objectives:
  - Define the purpose of normalization in database models
  - Define the rule of First Normal Form in the normalization process
  - Determine if an entity conforms to the rule of First Normal Form
  - Convert an entity to First Normal Form if needed

This course discusses the first three rules of normalization. You should be aware that there are more. Normalization can go from First Normal Form (1NF) all the way to Fifth Normal Form (5NF) and beyond (6NF and 7NF are mostly academic exercises). For most business models, 3NF is enough.

Normalization is a very formal term that can be intimidating to some students. Explain that although normalization is derived from complex mathematical rules, the data modeler's goal is to eliminate redundancy.

Purpose

- Think about storing your friends' phone numbers in three different places:
  - your address book, your cell phone, and a sheet of paper that you have taped to your refrigerator
- It's a lot of work if a friend changes his/her phone number
- You have to change it in your address book, cell phone, and the sheet of paper taped to your refrigerator

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Normalization can be a difficult concept to learn. At the very basic level, it just seems like common sense – make sure you don't store the same data twice in the model, and that you store data in the correct place. However, the rules of normalization are formal statements that can involve complex language.

Purpose

- What happens if data is stored in more than one place in a database?
- What if someone changes the information in one place and not the other—how do you know which information is correct?
- Redundancy like this causes unnecessary problems in a database

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Normalization: A series of steps followed to obtain a database design that allows for efficient access and storage of data in a relational database. These steps reduce data redundancy and the chances of data becoming inconsistent.
Redundancy: Something that is unnecessarily repetitive; the state of being unnecessarily repetitive.

A useful memory aid: some legal systems require that a witness in court swears to tell “the truth, the whole truth and nothing but the truth”. One way of stating the normalization rules is that “Every non-UID attribute must be dependent on the UID, the whole UID, and nothing but the UID”.

Purpose

- Normalization is a process that is used to eliminate these kinds of problems
- One of your goals as a database designer is to "store information in one place and in the best possible place“
- If you follow the rules of normalization, you will achieve this goal

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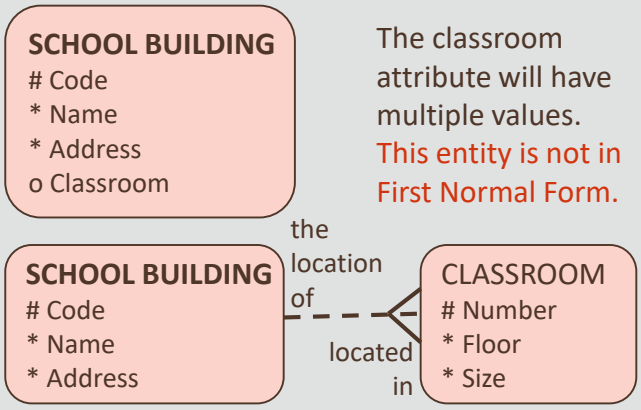
First Normal Form (1NF)

- First Normal Form requires that no multi-valued attributes exist
- To check for 1NF, validate that each attribute has a single value for each instance of the entity
- One code, one name, and one address exist for the school building, but not one classroom

SCHOOL BUILDING 1NF



CLASSROOM is now its own entity.
All attributes have only one value per instance.
Both entities are in First Normal Form.

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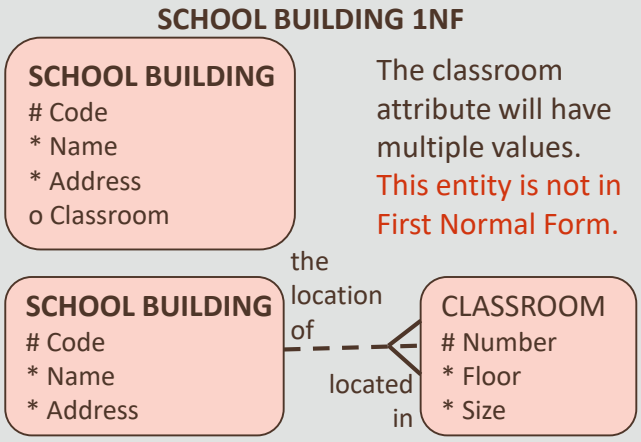
"For school building code 15, what is the address?" There is only one value of the address. But "For school building 15, what is the classroom number?" Many values – so this entity is not in First Normal Form

First Normal Form (1NF)

- Since many classrooms exist in a school building, classroom is multi-valued and violates 1NF
- If an attribute is multi-valued, create an additional entity and relate it to the original entity with a 1:M relationship



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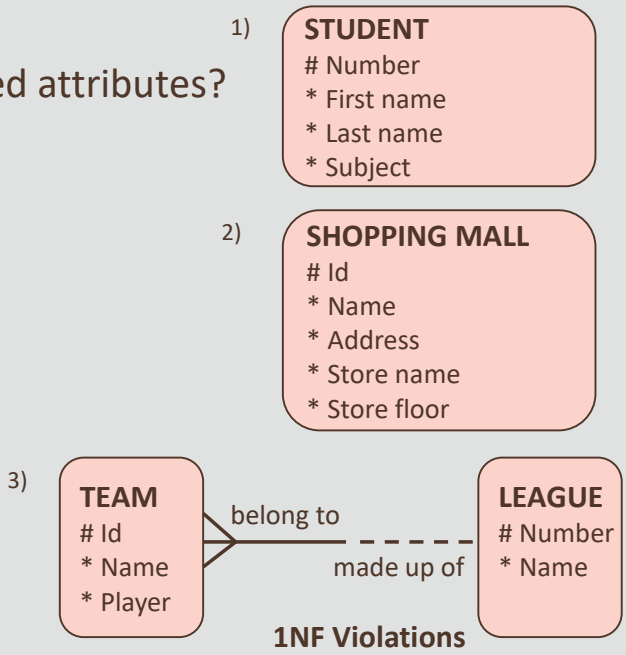
1NF eliminates repeating groups (multiple values) within an attribute by transferring the attribute to a new entity and then connecting the entities with a 1:M relationship.

1NF Violations

- Examine the entities:
  - Are there any multi-valued attributes?



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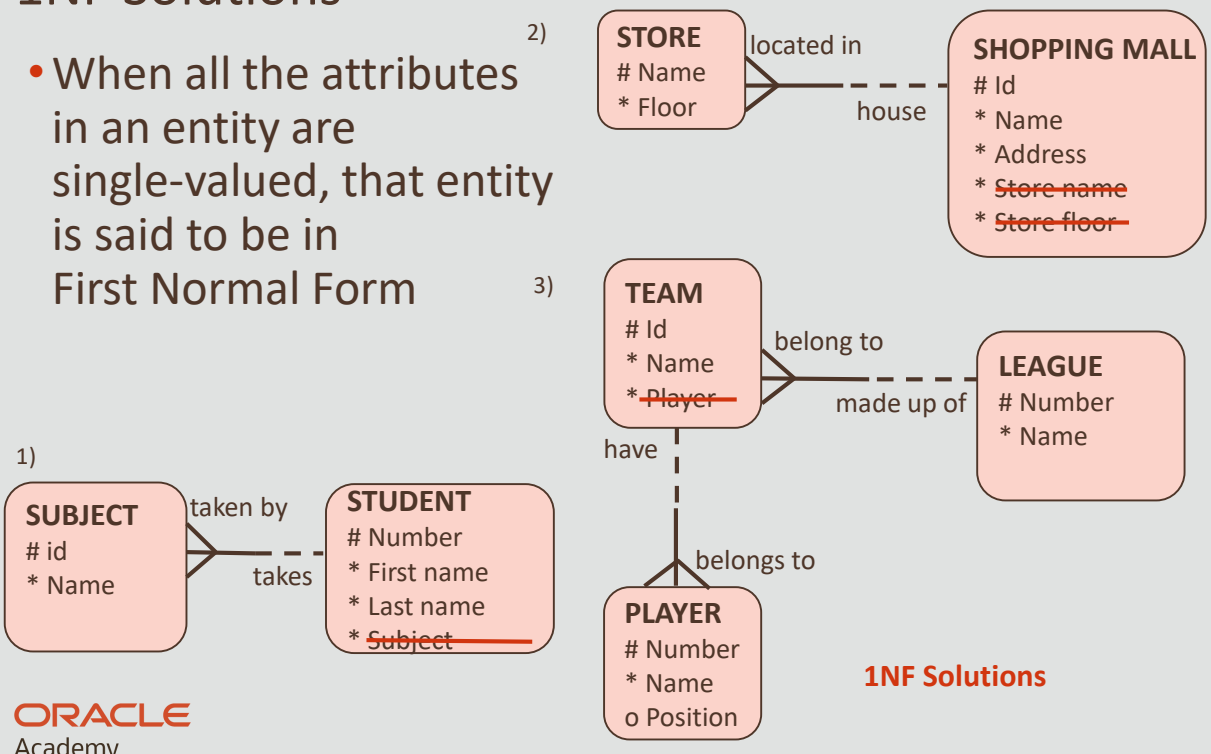
1. There are many subjects that can be associated with a STUDENT. The subject attribute is misplaced because it is multi-valued.
2. A SHOPPING MALL has more than one store. Store name and store floor are attributes with multiple values and should not be in the SHOPPING MALL entity.
3. A TEAM has several players, so the player attribute has multiple values.

1NF Solutions

- When all the attributes in an entity are single-valued, that entity is said to be in First Normal Form



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First Normal Form (1NF)
First Normal Form requires that there be no multi-valued attributes and no repeating groups. To check for First Normal Form, validate that each attribute has a single value for each instance of the entity.

Terminology

- Key terms used in this lesson included:
  - First Normal Form (1NF)
  - Normalization
  - Redundancy

Summary

- In this lesson, you should have learned how to:
  - Define the purpose of normalization in database models
  - Define the rule of First Normal Form in the normalization process
  - Determine if an entity conforms to the rule of First Normal Form
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