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Database Design

2-2

Entities, Instances, Attributes, and Identifiers

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In this lesson we look at the concepts of Entities and Instances and identifying Attributes and Unique Identifiers for Entities

Objectives

- This lesson covers the following objectives:
  - Define and give an example of an entity
  - Distinguish between an entity and an instance of an entity
  - Name and describe attributes for a given entity
  - Distinguish between an attribute and its value
  - Distinguish between mandatory and optional attributes, and between volatile and nonvolatile attributes
  - Select and justify a unique identifier (UID) for an entity

Purpose of Entities

- Knowing how to organize and classify data makes it possible to draw useful conclusions about seemingly random facts
- Our technology-rich world produces vast quantities of facts in need of structure and order
- It is important to learn about entities because they are the things about which we store data
- For example:
  - A school needs to store data about (as a minimum): STUDENTs, TEACHERs, COURSEs, ROOMs, GRADEs

What kinds of information would we need to know, or work with, in each of these jobs:
IT programmer/consultant
Bank manager
Restaurant cashier
Artist
Parent

Purpose of Attributes

- It is important to learn about attributes because they provide more specific information about an entity
- Attributes help you distinguish between one instance and another by providing greater detail for the entity
- For example:
  - In a restaurant, you need to list the individual items on a customer's order so that you can calculate the bill
  - When building several sales reports, you must be able to identify a specific report from the list of reports

Purpose Unique Identifiers

- What about unique identifiers?
  - It is important to learn about unique identifiers because they distinguish one instance of an entity from another
  - For example:
    - In a classroom, you need to distinguish between one student and another
    - When classifying your CD collection, you need to distinguish between one CD and another
    - When listing transactions on a financial statement, you need to distinguish between one transaction and another

Instance: An occurrence or example

Identifying Purpose

- Look at the magazine advertisements and the Internet sites identified by the teacher
- What is the “main thing” that each ad or website is about?

look at commercial websites.
Some suggestions are:
http://www.nike.com - sports equipment
http://www.weyl.com - beef industry
http://carmax.com - used cars
http://www.hallmark.com - greeting cards
http://www.sephora.com - beauty products
http://telstra.com - communication
http://changan.com – automobiles

Entity Defined

- An entity is:
  - "Something" of significance to the business about which data must be known
  - A name for a set of similar things that you can list
  - Usually a noun
  - Examples: objects, events, people
  - Entities have instances
  - An instance is a single occurrence of an entity

Entities and Instances

Entities	Instances
PERSON	Mahatma Gandhi, George Washington
PRODUCT	Nike Air Jordan, Gibson Les Paul Custom
PRODUCT TYPE	Shoe, Video Game
JOB	Electrician, IT Technician
SKILL LEVEL	Beginner, Expert
CONCERT	U2 at the Palladium, Beyoncé at the Greek Theatre L.A.
ANIMAL	Dog, Cat
CAR	Volkswagen Beetle, Toyota Corolla

Example: The Entity FRUIT has instances of orange, apple, peach, kiwi, cherry, lime, lemon, etc.

Entities and Instances

- A Dalmatian, a Siamese cat, a cow and a pig are instances of ANIMAL
- A convertible, a sedan and a station wagon are instances of CAR
- Some entities have many instances and some have only a few
- Entities can be:
  - Tangible, like PERSON or PRODUCT
  - Intangible, like SKILL LEVEL
  - An event, like CONCERT

Nontangible: Incapable of being perceived by the senses.
Tangible: Perceptible to the senses, especially the sense of touch

Entities and Instances

- Is DOG an instance or an entity?
  - It depends:
    - If we consider many different kinds of animals, it makes sense to think of the entity ANIMAL to include instances DOG, CAT, HORSE and so on
    - But what if we run a dog-breeding business? We will need to keep data on many different breeds of dog, but not on other species of animal
    - For a dog-breeder, it is more natural to think of an entity DOG to include instances TERRIER, POODLE, LABRADOR and so on

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It would not make sense to have an entity with only one instance

What is an Attribute?

- Like an entity, an attribute represents something of significance to the business
- An attribute is a specific piece of information that helps:
  - Describe an entity
  - Quantify an entity
  - Qualify an entity
  - Classify an entity
  - Specify an entity
- An attribute has a single value

Assume that all entities have at least one attribute. Later, we will discover exceptions to this assumption. Usually, there are many attributes for an entity, but again, we are interested only in those attributes that are of importance to the business.
Example: The Entity FRUIT has attributes of name, type, region, and date picked.
An instance of this would be:
Orange, citrus, west coast, 10-APR-2005

Attributes

- Attributes have values. An attribute value can be a number, a character string, a date, an image, a sound, etc
- These are called "data types" or "formats"
- Every attribute stores one piece of data of one specific data type

Entities	Attributes
CUSTOMER	family name, date of birth, shoe size, town of residence, email
CAR	model, weight, catalog price
ORDER	order date, ship date
JOB	title, description
TRANSACTION	amount, transaction date
EMPLOYMENT CONTRACT	start date, salary

Data type: A classification identifying one of various types of data, stating the possible values for that type, the operations that can be done on that type, and the way the values of that type are stored
Single-valued: Can only have one value at any point for each instance in the entity

Attributes

- What is the data type of each attribute in CUSTOMER?
  - For example:
    - family name is a character string, attributes are single-valued
    - Each attribute can have only one value (at any point in time) for each instance of the entity

Entities	Attributes
CUSTOMER	family name, age, shoe size, town of residence, email
CAR	model, weight, catalog price
ORDER	order date, ship date
JOB	title, description
TRANSACTION	amount, transaction date
EMPLOYMENT CONTRACT	start date, salary

Attributes:
The only attributes we need to model are those that the business wants to track. So for example, you may want to track shoe size as an attribute of customer if you are a shoe store, but maybe not if you are a grocery store. It all depends on the business requirements.

Every attribute has a data type. For example, the attribute “name” has a data type of character string (text), the attribute “salary” has a data type of number, and the attribute “photograph” has a data type of image.

Attribute Is Single-Valued
An attribute for an entity must be single-valued. In more precise terms, an instance of an entity can have only one value for each attribute at any point in time. This is the most important characteristic of an attribute. The attribute value, however, may change over time.
For example: The entity CAR may have attributes “model” and “color.” There can be only one value for these (for example, “Beetle” and “green”) at one time, for each instance (i.e. for each individual car). Although the model remains the same over the lifetime of the car, its color can change.

Attributes

- Some attributes (such as age) have values that constantly change
- These are called volatile attributes
- Other attributes (such as order date) will rarely change, if ever
- These are nonvolatile attributes
- If given a choice, select the nonvolatile attribute
- For example, use birth date instead of age

Volatile: Highly changeable
One reason for preferring nonvolatile attributes (if there is a choice) is that volatile attributes will need to be updated frequently. For example, age must be updated every year. How long would this take if we had 1 million customers? If we need to know a customer's age, we can easily deduce it from the birth date.

Attributes

- Some attributes must contain a value—these are mandatory attributes
- For example: in most businesses that track personal information, name is required
- Other attributes may either contain a value or be left null—these are optional attributes
- For example: cell phone number is often optional except in mobile or wireless applications

Mandatory: Required
Null: A value that is unavailable, unassigned, unknown, or empty; it is neither a zero nor a space
Optional: Not required

Attributes

- Example: Email address could be a mandatory attribute for EMPLOYEE in an email application, but an optional attribute for CUSTOMER in an online catalog

Attributes

- If we were to model a Human Resource system, we would have an entity to store data for each worker called EMPLOYEE
- What attributes does EMPLOYEE have?
- Give one or two examples of the values that each EMPLOYEE attribute might contain

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Possible answers for attributes may include:
First Name
Last name
Address
Salary
Social Security Number

Identifiers

- An EMPLOYEE has a unique identifier (UID)
- A UID is either a single attribute or a combination of multiple attributes that distinguishes one employee from another
- How do you find a specific employee that works for the company?
- What information uniquely identifies one EMPLOYEE?

Identifiers

- Think about all the students in the classroom
- Each student is described by several traits or attributes
- Which attribute or attributes allow you to pick a single student from the rest of the class?
- That is the student's UID

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What combination of traits uniquely identifies a single STUDENT?

Student's name? No, there could be two students with the same name.
Date of birth? No, there could be two students born on the same day.

For almost any combination of student attributes, it is at least possible that two students could have the same combination of values.

This is why for entities such as STUDENT, we create an artificial student number or student ID.

Terminology

- Key terms used in this lesson included:
  - Attribute
  - Data type
  - Entity
  - Instance
  - Mandatory
  - Intangible

Terminology

- Key terms used in this lesson included:
  - Null
  - Optional
  - Single valued
  - Tangible
  - Unique identifier (UID)
  - Volatile

Summary

- In this lesson, you should have learned how to:
  - Define and give an example of an entity
  - Distinguish between an entity and an instance of an entity
  - Name and describe attributes for a given entity
  - Distinguish between an attribute and its value
  - Distinguish between mandatory and optional attributes, and between volatile and nonvolatile attributes
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