The Entity-Relationship Model

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September 23, 2009

Till the Midterm Examination

- Relational Data Models
  - The Entity-Relationship (ER) model
  - The relational model
  - Converting E/R diagram to relational designs.
- At this point, you will know how to
  1. Identify all entities and relationships and describe them using an E/R diagram .
  2. Convert the E/R model to a number of relations in a relational schema.
- Use all these ideas to design your own database application in your project.

Basic Database Terminology

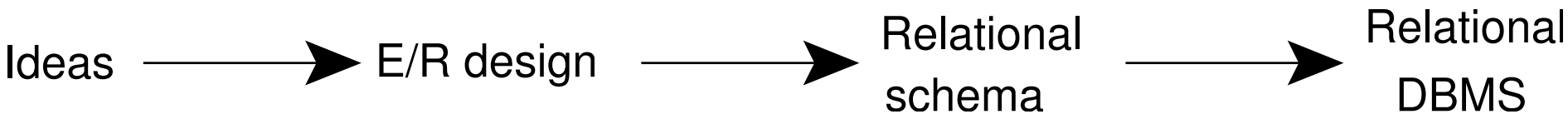
- *Data model*: describes high-level conceptual structuring of data
  - Example: Data is set of student records, each with ID, name, address, and courses
  - Example: Data is a graph where nodes represent proteins and edges represent chemical bonds between proteins
- *Schema* describes how data is to be structured and stored in a database
  - Defined during creation of the database
  - Schemas rarely change
- *Data* is actual "instance" of database
  - Updated continuously
  - Changes rapidly

Why Learn About Database Modelling?

- The way in which data is stored is very important for subsequent access and manipulation by SQL.
- Properties of a good data model:
  - It is easy to write correct and easy to understand queries.
  - Minor changes in the problem domain do not change the schema.
  - Major changes in the problem domain can be handled without too much difficulty.
  - Can support efficient database access.

Purpose of the E/R Model

- The *Entity-Relationship (E/R) model* enables us to draw diagrams of database designs
  - Represent different types of data and how they relate to each other.
- The design is a drawing called the *E/R diagram*.
- When designing E/R diagrams, forget about relations/tables; only consider how to model the information you need to represent in your database.
- In two weeks, we will learn how to convert an E/R diagram to a relational schema.



Entity Sets

- An entity is an (abstract) object of some sort.
- An entity set is a collection of similar entities.
- Entities have attributes
  - An attribute is a property of the entities in an entity set
  - In this class, our convention is to use "atomic" attributes (strings, numbers, ...)

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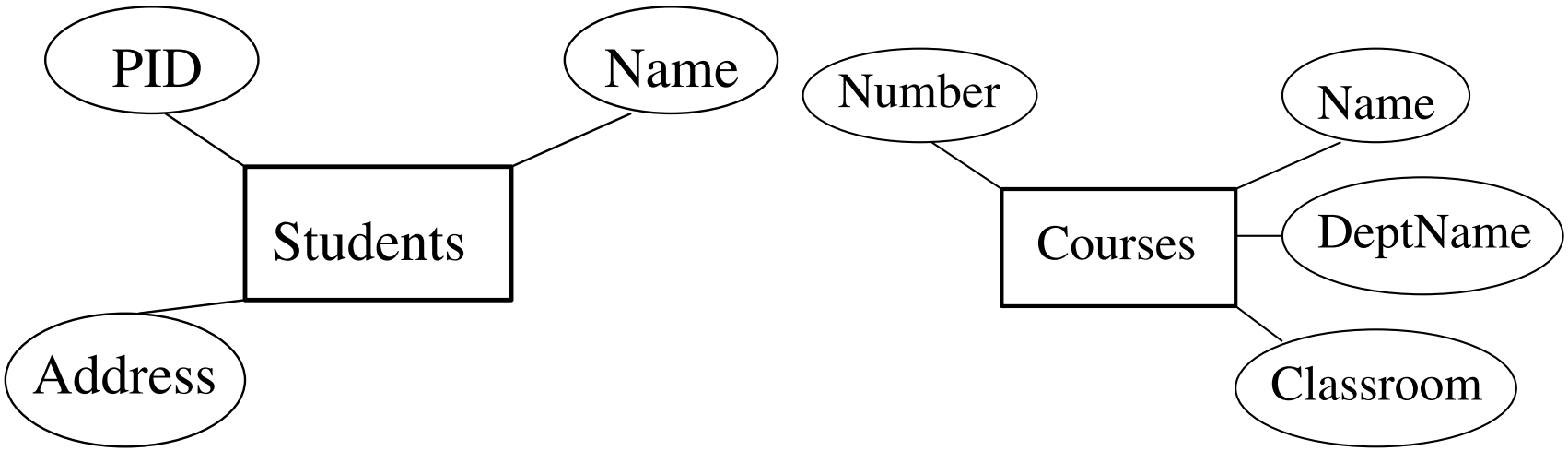
- Analogy between entity sets and classes (in OO languages)
- Analogy between entities and objects.

Entity Sets in an E/R Diagram

- In an E/R diagram
  - A rectangle represent an entity set
  - An oval represents an attribute
  - A line connects an entity set (rectangle) to an attribute (oval)

Examples of Entity Sets

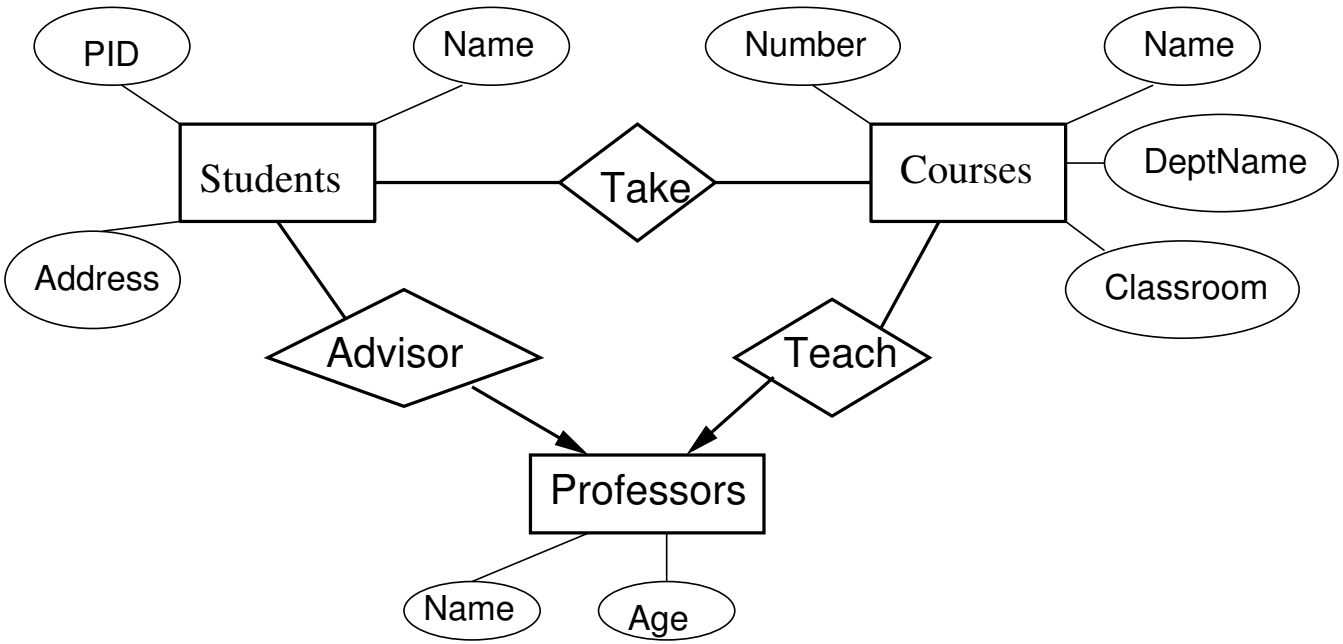


Relationships

- A relationship is a connection between two or more entity sets.
- In an E/R diagram,
  - a diamond represents a relationship
  - a line connects the relationship to each entity set.
- Do not confuse "Relationships" with "Relations".

Examples of Relationships

- *Students Take Courses, Professors Teach Courses, Professors Advise Students*



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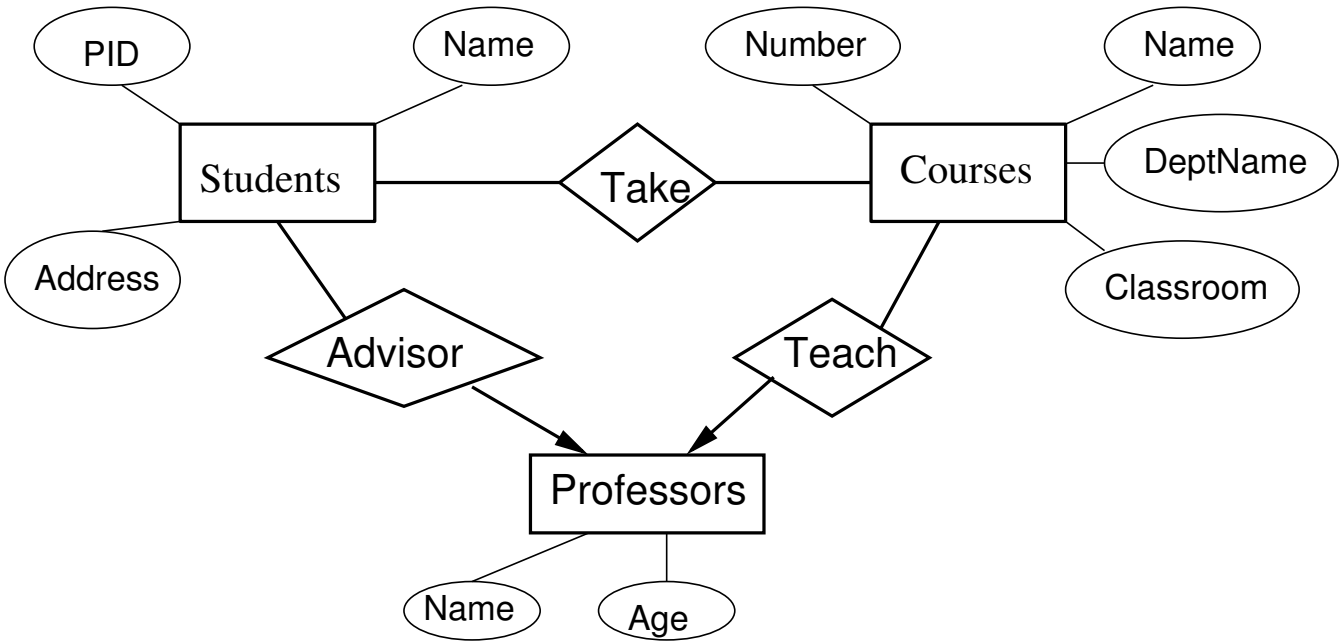

- Attributes types: strings, numbers, or "enums" (A *Professor*'s *Age* could be "old," "much older," or "still alive!").

Instance of an E/R Diagram

- An E/R diagram is a notation for specifying the schema (structure) of a database. It is not an implementation of a database.
- Still useful to think about the *instance* of an E-R diagram: the particular data stored in the database.

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- Example: An instance of the entity set `Students`

Name	*PID*	*Address*
Hermione Grainger	HG	Gryffindor Tower
Draco Malfoy	DM	Slytherin Tower
Harry Potter	HP	Gryffindor Tower
Ron Weasley	RW	Gryffindor Tower

Instance of a Relationship

- Example: An instance of the relationship `Takes` (no `DeptName`)

Student	*PID*	*Address*	*CourseName*	*Enrollment*	*Grade*
Hermione Grainger	HG	Gryffindor	Potions	∞	A-
Draco Malfoy	DM	Slytherin	Potions	∞	B
Harry Potter	HP	Gryffindor	Potions	∞	A
Ron Weasley	RW	Gryffindor	Potions	∞	C

- A relationship R between entity sets E and F relates some entities in E to some entities in F.
- R is a set of pairs of tuples (e, f) where e is in E and f is in F.
  - R need not relate every tuple in E with every tuple in F.
  - *Relationship set* for R: all pairs of tuples (e, f) related by R.
- An instance of R is simply the "concatentation" of the attribute lists for all pairs of tuples (e, f) in the relationship set for R.
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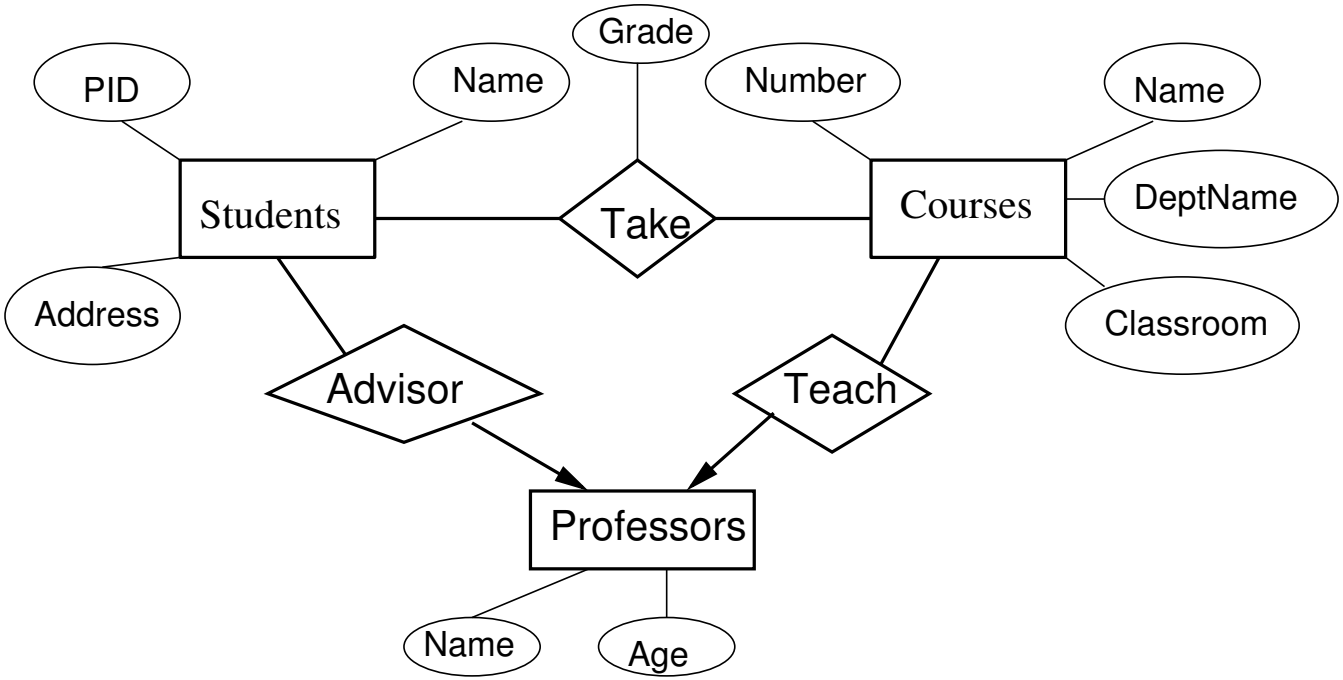
- "Tuples" in R have two components, one from E and one from F.
- Question: What is *Grade* an attribute of?

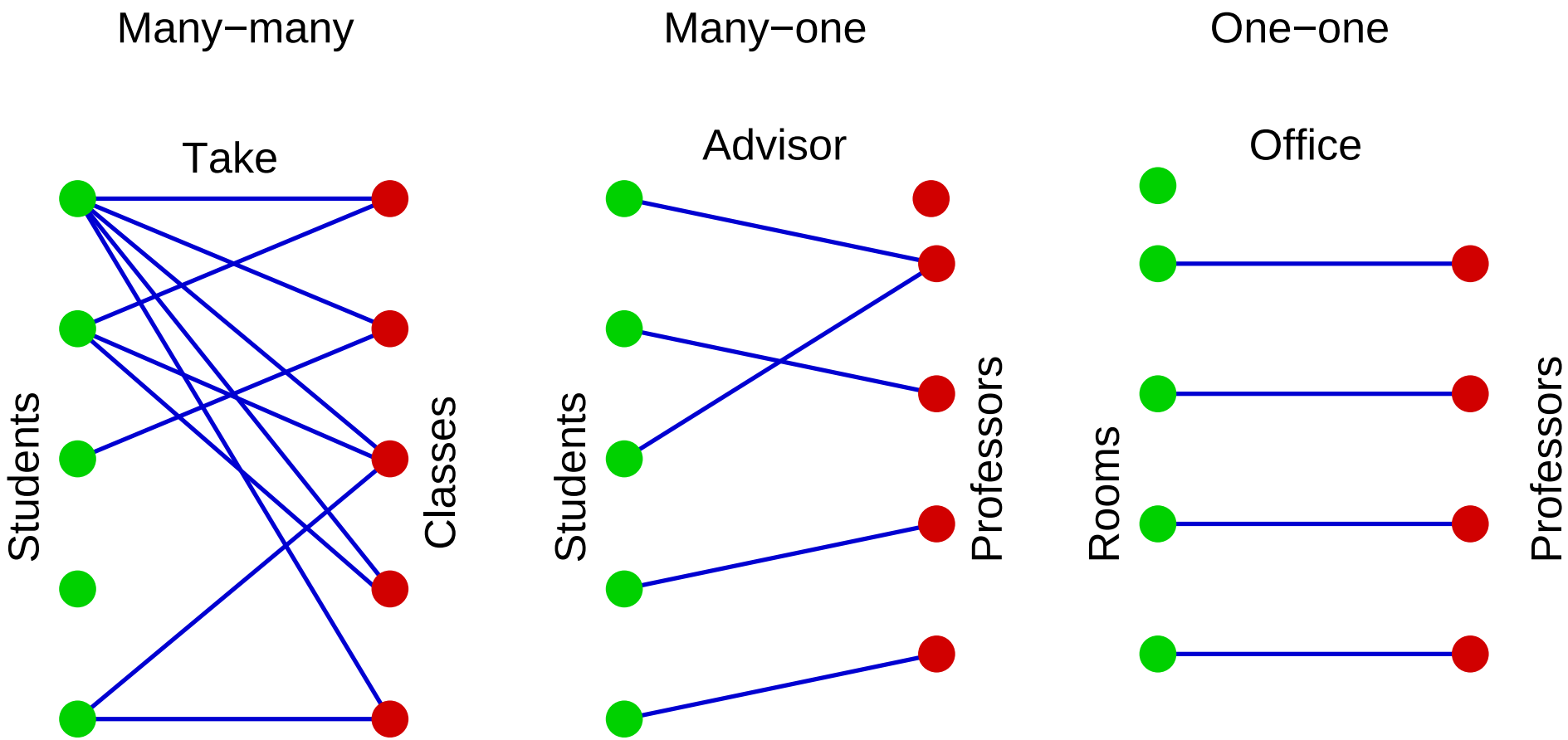
Attributes for a Relationship

- It is useful/essential to attach attributes to relationships.
- Such an attribute is a property of the entity-pairs in the relationship.



- What is the meaning of the arrow in the E-R diagram?

Multiplicity in Pictures



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  - "at most one" and not "at least one" or "exactly one".
- R is *one-one* if it is many-one from E to F and many-one from F to E.
- Otherwise, R is a *many-many* relationship.
- The schema defines the multiplicity of relationships. Don't use the instances of the schema to determine multiplicity.