CSc 322 - Software Engineering

Lab – Spring 2018

Teaching Assistant: Isatou Sanneh

Email: isanneh00@citymail.cuny.edu

Entity Relationship Diagram

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Entity, Attribute, and Relationship

- **Entity:**
  – Entity class (entity set) is a structural description of things that share common attributes
  – Entity instance is the occurrence of a particular entity
- **Attribute:**
  – Describes the properties of an entity class
  – All entity instances of a given entity class have the same attributes, but vary in the values of those attributes
  – Attribute Types:
    - ❖ Composite attribute: An attribute that can be further divided into more attributes. Example: Name, Address, etc
    - ❖ Multi-Value Attribute: An attribute that allows multiple values. Example: skills, phone numbers, etc.
    - ❖ Derived attribute: Attributes that can be calculated (derived) from other attributes. Example: age, total, interest, due date, etc.
- **Identifier or Key:**
  – Identifies an entity instance
  – The value of the identifier attribute is unique for each entity instance
- **Relationship**
  – Relationship describes how entities are related
  – Relationship features
    - ❖ Cardinality: Entity instance's participation count
    - ❖ Degree of Relationship: How many entities are involved in a relationship
  – Cardinality
    - ❖ Describes how many entity instances can be in the relationship
    - ❖ Maximum cardinality (type of relationship): Describes the maximum number of entity instances that participate in a relationship – One-to-one, One-to-many, Many-to-many.
    - ❖ Minimum cardinality: Describes the minimum number of entity instances that must participate in a relationship

Notation

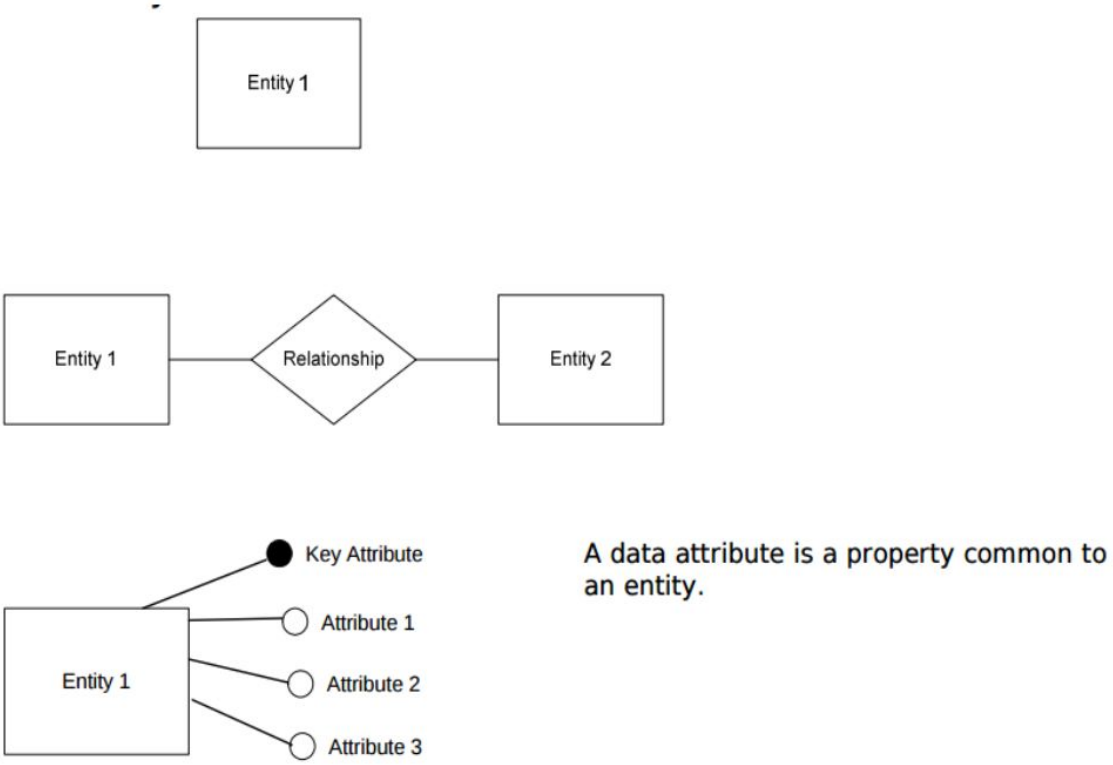


Figure 1: Graphical notations

Steps to create an ER Diagram

1. **Identify Entities:** Identify the entities.
2. **Find Relationships:** Discover the semantic relationships between entities. The easiest way to see all possible relationships is to build a table with the entities across the columns and down the rows, and fill in those cells where a relationship exists between entities.
3. **Draw Rough ER Diagram:** Draw the entities and relationships that you have discovered.
4. **Fill in Cardinality:** Determine the cardinality of the relationships. You may want to decide on cardinality when you are creating a relationship table.
5. **Define Primary Keys:** Identify attribute(s) that uniquely identify each entity.
6. **Draw Key-Based ER Diagram:** Now add them (the primary key attributes) to your ER Diagram. Revise your diagram to eliminate many-to-many relationships, and tag all foreign keys .
7. **Identify Attributes:** Identify all entity characteristics relevant to the domain being analyzed.

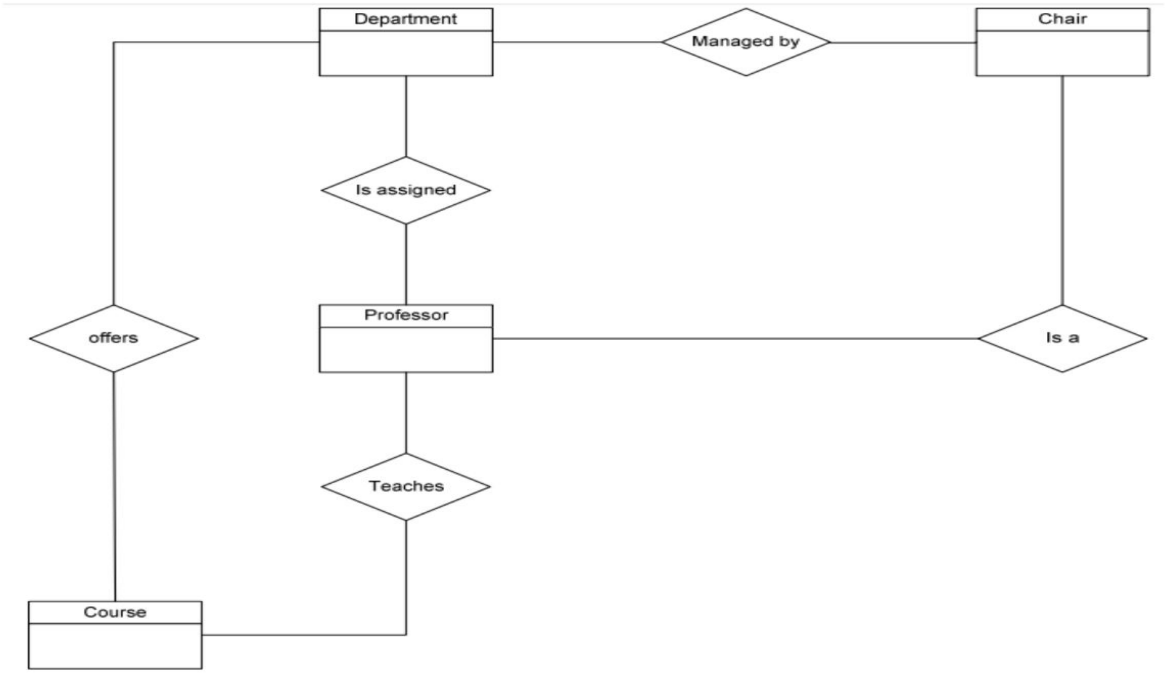
8. **Map Attributes:** Determine which entity each characteristic belongs to. Do not duplicate attributes across entities. If necessary, put them in a new, related, entity.
9. **Draw fully attributed ER Diagram:** Now add these attributes. The diagram may need to be modified to accommodate new entities if necessary.

Example The University of Toronto has several departments. Each department is managed by a chair, and at least one professor. Professors must be assigned to one, but possibly more departments. At least one professor teaches each course, but a professor may be on sabbatical and not teach any course. Each course may be taught more than once by different professors. We know of the department name, the professor name, the professor employee id, the course names, the course schedule, the term/year that the course is taught, the department(s) the professor is assigned to, the department that offers the course.

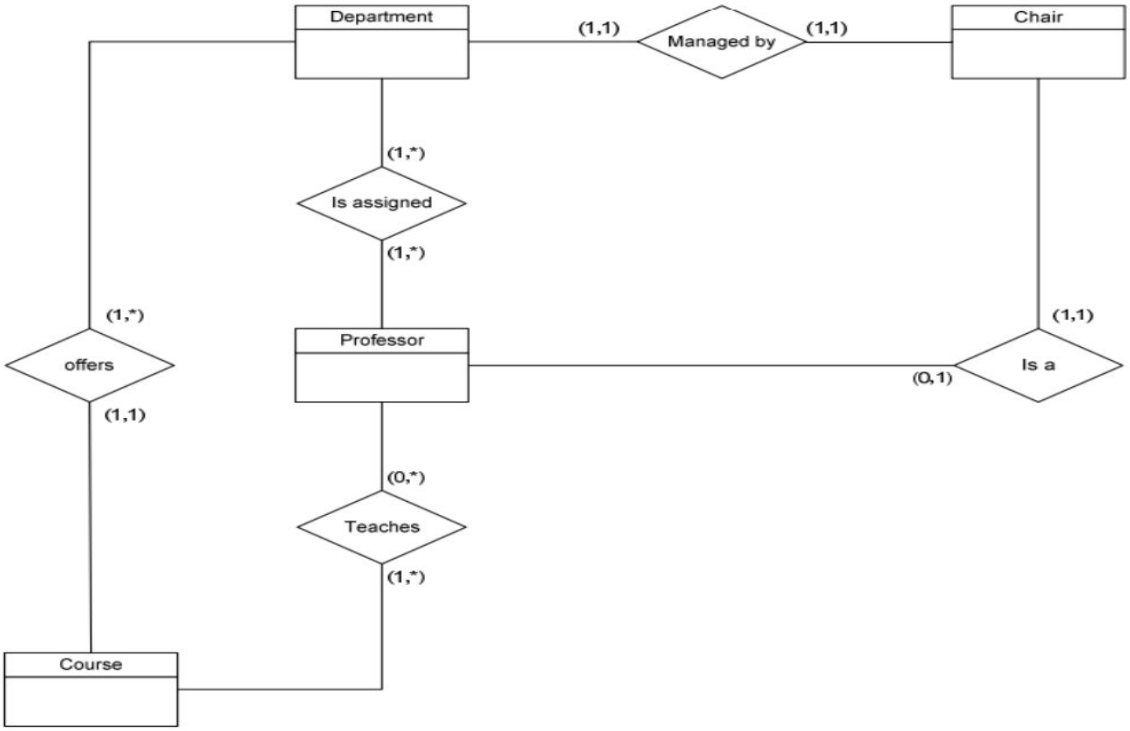
1. **Identify Entities:** Identify the entities. These are typically the nouns and noun-phrases in the descriptive data produced in your analysis. Do not include entities that are irrelevant to your domain. The entity candidates are department, department chair, professor, course, and course section. Since there is only one instance of the University of Toronto, we exclude it from our consideration.
2. **Find Relationships:** Discover the semantic relationships between entities. These are usually the verbs that connect the nouns. The easiest way to see all possible relationships is to build a table with the entities across the columns and down the rows, and fill in those cells where a relationship exists between entities.

	department	chair	professor	course
department		managed by	is assigned	offers
chair	manages		is a	
professor	assigned to			teaches
course	offered by		taught by	

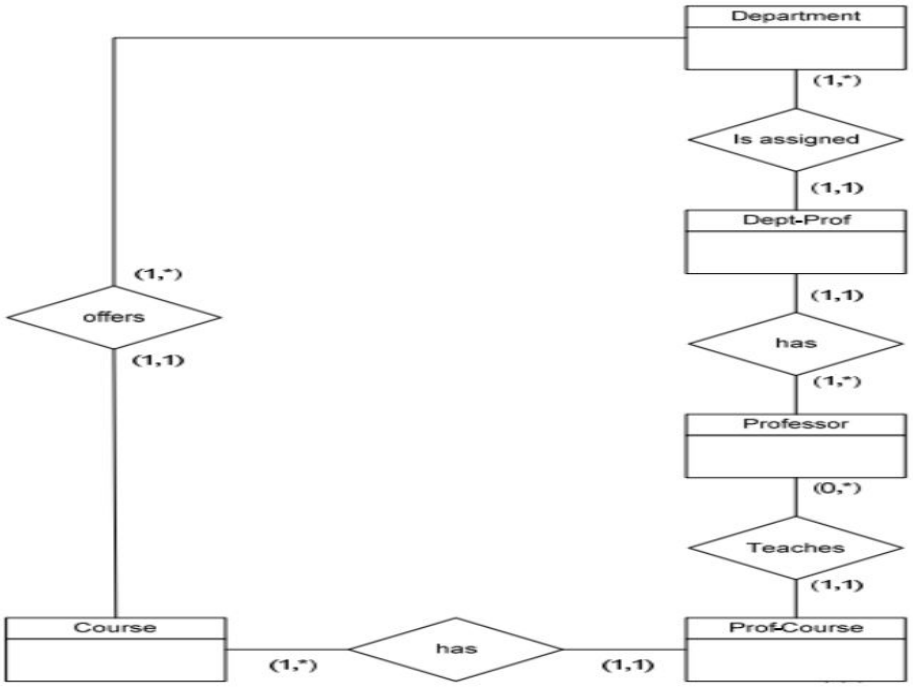
3. **Draw Rough ER Diagram:**



4. **Fill in Cardinality:**

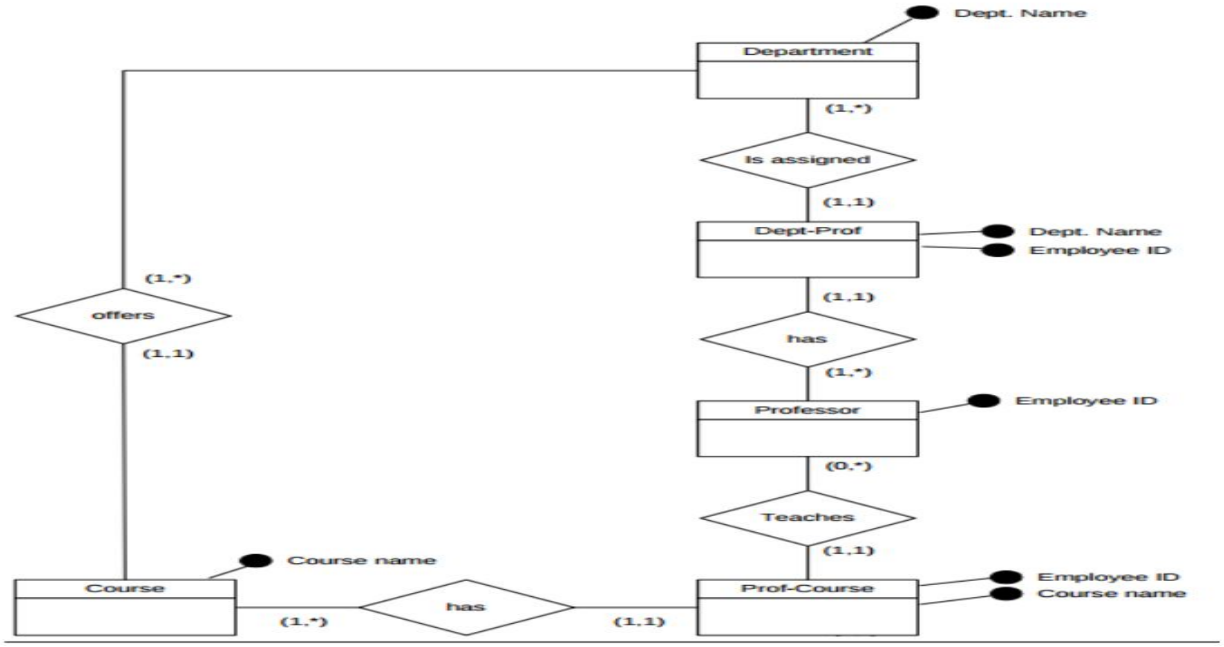


Here we must eliminate many-to-many relationships, and collapse one-to-one relationships where it makes sense. For example, the department chair, without any behaviours, is really just an attribute of a department. So we can remove it as an entity and later add it as an attribute.



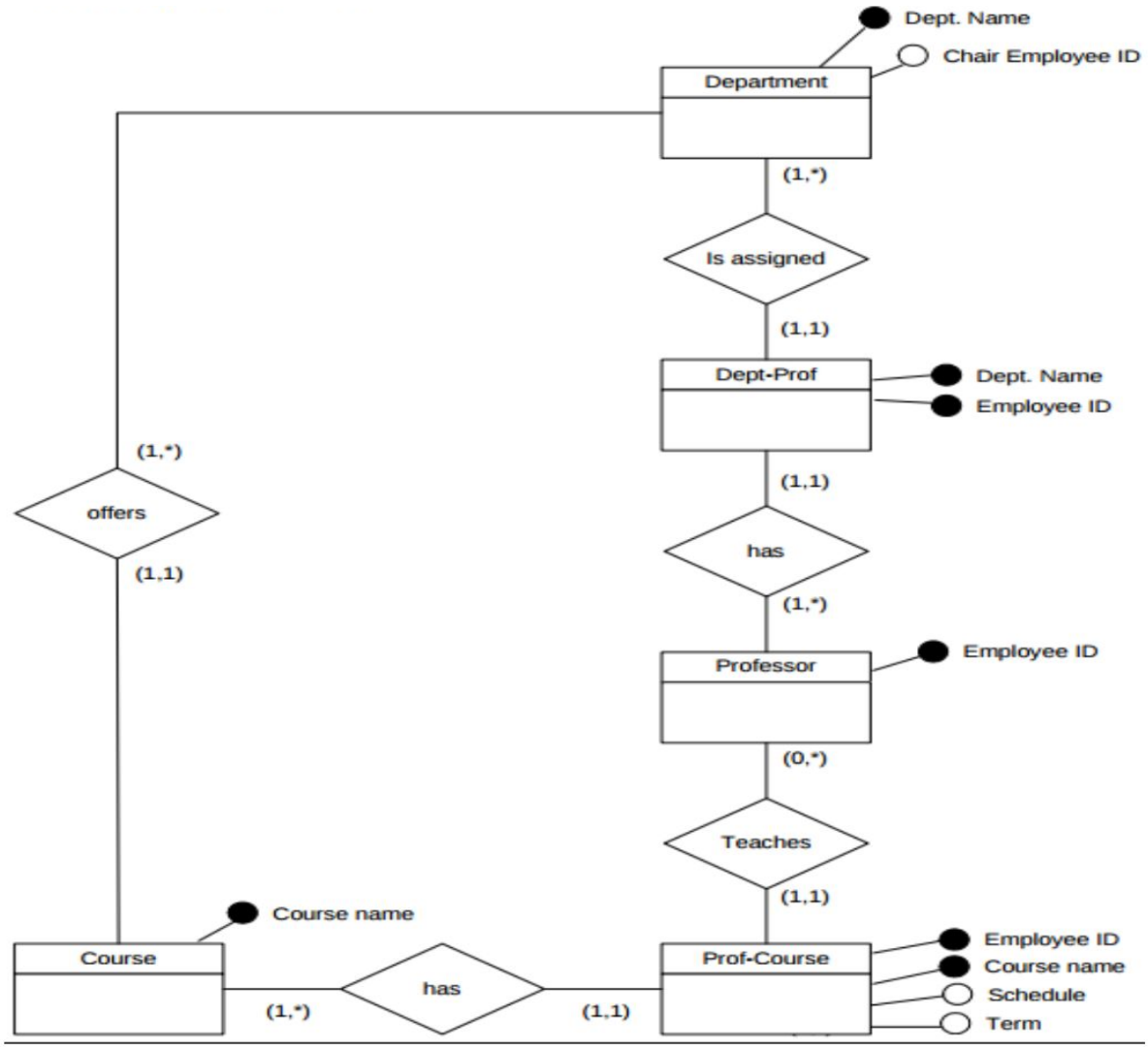
5. **Define Primary Keys:** Identify attribute(s) that uniquely identify each entity.

6. **Draw Key-Based ER Diagram:** Now add them (the primary key attributes) to your ER Diagram. Revise your diagram to eliminate many-to-many relationships and tag all foreign keys.



7. **Identify Attributes:** Identify all entity characteristics relevant to the domain being analyzed excluding those keys already identified: Schedule, Term, Professor Name, Department Chair (which is an employee ID, a foreign key to Professor).
8. **Map Attributes:** Determine which entity each attribute belongs to. Do not duplicate attributes across entities. If necessary, put them in a new, related entity.

9. **Draw fully attributed ER Diagram:** Now add these attributes. The diagram may need to be modified to accommodate necessary new entities.



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