ER Diagram

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Representing Cardinality Constraints in ER Diagram

- We express cardinality constraints by drawing either a directed line (→), signifying **one** or an undirected line (—), signifying **many** between the relationship set and the entity set

- **One-to-one** relationship between an **instructor** and a **student**
  - A **student** is associated with at most one **instructor** via the relationship **advisor**
  - A **student** is associated with at most one department via **stud_dept**

- **One-to-many** relationship between an **instructor** and a **student**
  - An **instructor** is associated with several (including 0) **students** via **advisor**
  - A **student** is associated with at most one **instructor** via **advisor**

- In a **many-to-one** relationship between an **instructor** and a **student**
  - an **instructor** is associated with at most one **student** via **advisor**
  - and a **student** is associated with several (including 0) **instructors** via **advisor**

- In a **many-to-many** relationship between an **instructor** and a **student**
  - An **instructor** is associated with several (possibly 0) **students** via **advisor**
  - A **student** is associated with several (possibly 0) **instructors** via **advisor**
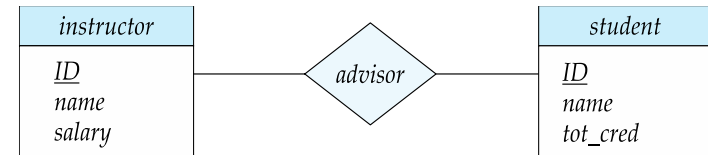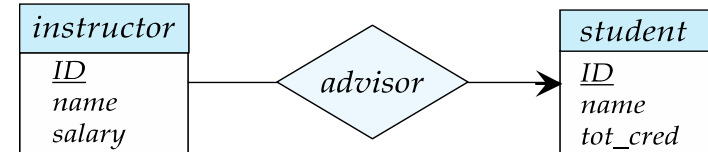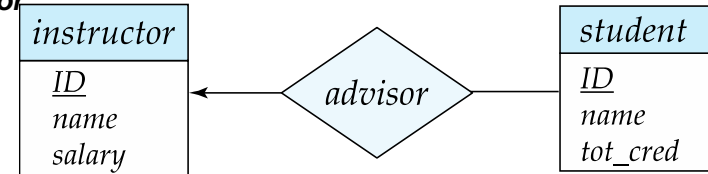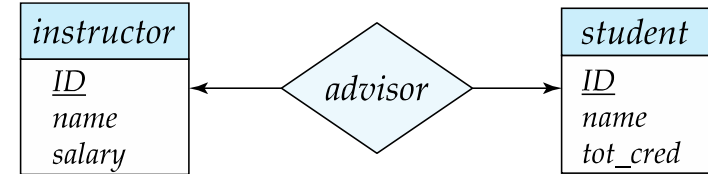
Roles

- Entity sets of a relationship need not be distinct

- Each occurrence of an entity set plays a *role* in the relationship

- They specify how *employee* entities interact via the *works-for* relationship set

- Roles are indicated in ER diagrams by labeling the lines that connect diamonds to rectangles

- Role labels are optional, and are used to clarify semantics of the relationship

    - The labels "*manager*" and *worker* are called roles

    - Similarly, the labels *course_id* and *prereq_id* are called roles
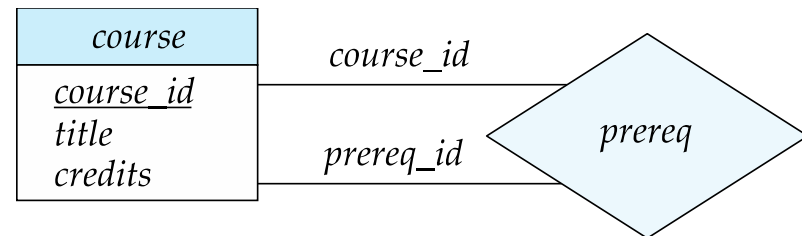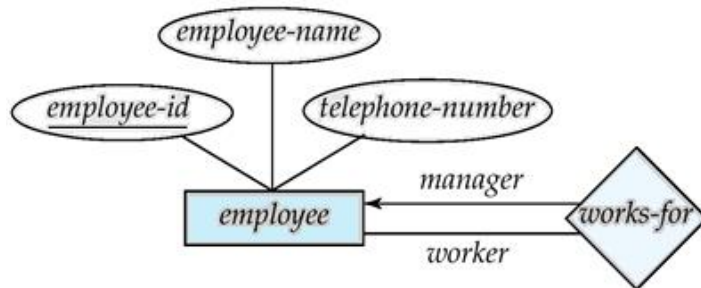
# Participation of an Entity Set in a Relationship Set

- Total participation (indicated by double line): Every entity in the entity set participates in at least one relationship in the relationship set

  - Participation of **student** in **advisor** relation is total

  - Every **student** must have an associated **instructor**

  - Participation of **loan** in **borrower** is total

  - Every **loan** must have a **customer** associated to it via **borrower**

- Partial participation: Some entities may not participate in any relationship in the relationship set

  - Participation of **instructor** in **advisor** is partial

  - Participation of **customer** in **borrower** is partial
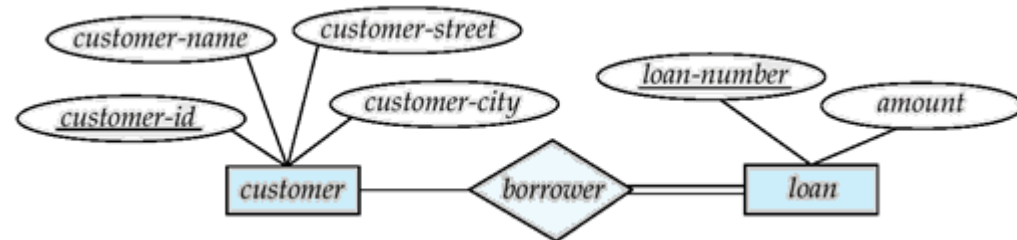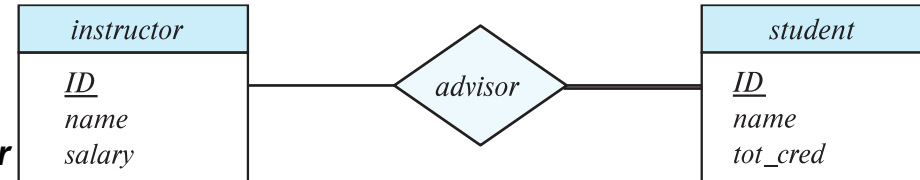
Complex Constraints for Cardinality Limits

- A line may have an associated minimum and maximum cardinality, shown
  in the form **l..h**, where **l** is the minimum and **h** the maximum cardinality

  – A minimum value of **1** indicates total participation

  – A maximum value of **1** indicates that the entity participates in at most
    one relationship

  – A maximum value of ***** indicates no limit

    o Example: **Instructor** can advise 0 or more **students**

    o A **student** must have 1 **advisor**; cannot have multiple **advisors**
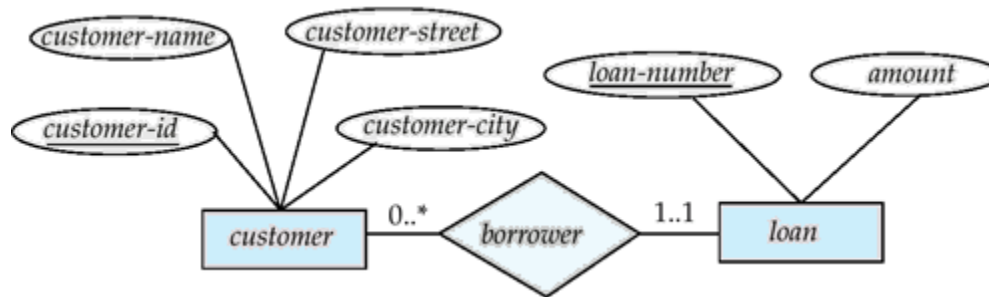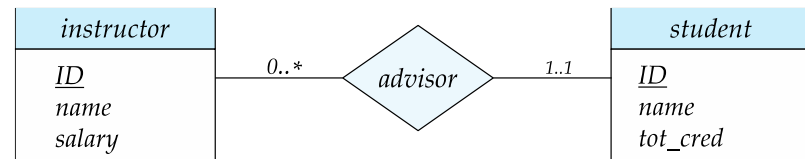
Cardinality Constraints on Ternary Relationship

- At most one arrow can be out of a ternary (or greater degree) relationship to indicate a cardinality constraint

- For example, an arrow from **proj_guide** to instructor indicates each **student** has at most one guide for a **project**

- If there is more than one arrow, there are two ways of defining the meaning:

  – For example, a ternary relationship **R** between **A**, **B** and **C** with arrows to **B** and **C** could mean

    o Each **A** entity is associated with a unique entity from **B** and **C** or

    o Each pair of entities from **(A, B)** is associated with a unique **C** entity, and each pair **(A, C)** is associated with a unique **B**

  – Each alternative has been used in different formalisms

  – To avoid confusion we outlaw more than one arrow

ER Diagram with a Ternary Relationship:
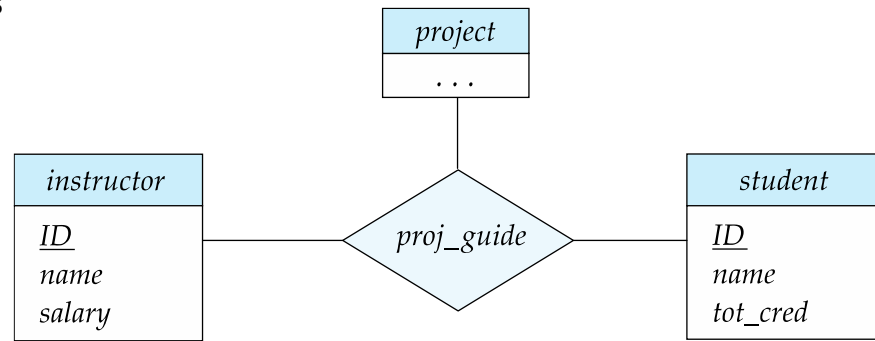
Binary Vs. Non-Binary Relationships

- Some relationships that appear to be non-binary may be better represented using binary relationships
    - Example: A ternary relationship **parents**, relating a child to his/her father and mother, is best replaced by two binary relationships, **father** and **mother**
        - Using two binary relationships allows partial information (for example only mother being know)
    - But there are some relationships that are naturally non-binary
        - Example: proj_guide

Converting Non-Binary Relationships to Binary Form

- In general, any non-binary relationship can be represented using binary relationships by creating an artificial entity set
    - Replace **R** between entity sets **A, B** and **C** by an entity set **E**, and three relationship sets are:
        - **R_A**, relating **E** and **A**
        - **R_B**, relating **E** and **B**
        - **R_C**, relating **E** and **C**
    - Create a special identifying attribute for **E**
    - Add any attributes of **R** to **E**
    - For each relationship (a_i , b_i , c_i) in **R**, create

A new entity e_i in the entity set **E**
Add (e_i , a_i) to **R_A**
Add (e_i , b_i) to **R_B**
Add (e_i , c_i) to **R_C**

Converting Non-Binary Relationships to Binary Form

- Also need to translate constraints
    - Translating all constraints may not be possible
    - There may be instances in the translated schema that cannot correspond to any instance of **R**
        - Alert: Add constraints to the relationships R_A, R_B, and R_C to ensure that a newly created entity corresponds to exactly one entity in each of entity sets **A, B,** and **C**
    - We can avoid creating an identifying attribute by making **E** a **weak entity** set identified by the three relationship sets
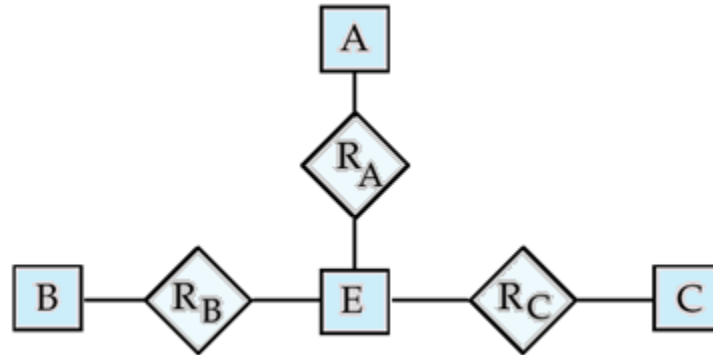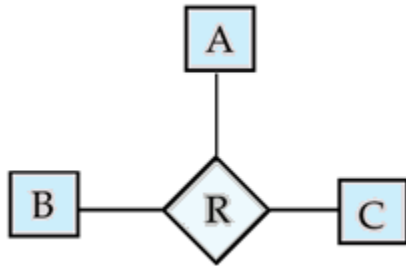
Design Issues

- **Use of entity sets vs. attributes**
  - Choice mainly depends on the structure of the enterprise being modeled, and on the semantics associated with the attribute in question

- **Use of entity sets vs. relationship sets**
  - Possible guideline is to designate a relationship set to describe an action that occurs between entities

- **Binary versus N-ary relationship sets**
  - Although it is possible to replace any nonbinary (N-ary, for N > 2) relationship set by a number of distinct binary relationship sets, a N-ary relationship set shows more clearly that several entities participate in a single relationship

- **Placement of relationship attributes**

Next Lecture

ER Diagram

Thank you for your attention...

Any question?

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