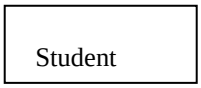
Session 2: E-R Data Model (CH-2)
CSCI-585, Cyrus Shahabi

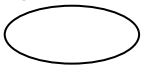
- Data Model: A collection of conceptual tools for describing data, data relationships, data semantics & consistency constraints. Example: Entity Relationships Data Model (E-R model)
- Based on a perception of a real world which consists of a set of basic objects called entities and relationships among these objects.
- Entity: An entity is an object that exists and is distinguishable from other objects (e.g., Tony with SS#, csci585 in Spring-2001, …)
- Entity set: A set of entities of the same type (e.g., students, courses).

Presented as:



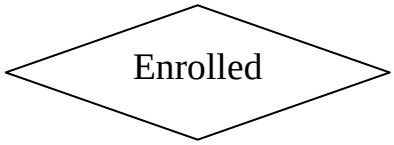
- Entity sets need not to be disjoint (e.g., Pamu (TA) is both a student and an employee of USC)
- Attributes: An entity is represented by a set of attributes (e.g., student: name, SS#, age, address, …). Attribute can be considered as a function that maps an entity into a domain (e.g., SS#: entity->integer).

Presented as:

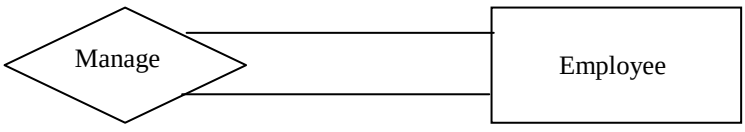


- Relationship: A relationship is an association among several entities (e.g., enrolled relationship associates Tony with cscsi-585)
- Relationship set: A set of relationships with the same type. Formal definition:

Presented as:



- Role: The function that an entity plays in a relationship is called its role. Normally implicit.
- Recursive relationship: Same entity set participates more than once in a relationship in different roles. Role names, hence, become essential:



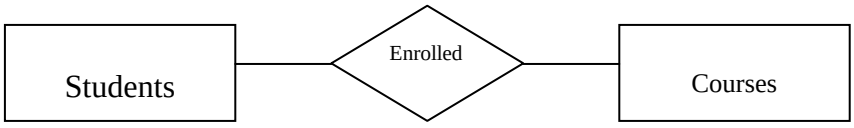
- Mapping cardinalities (example of definition of constraints in a data model): The number of entities to which another entity can be associated via a relationship set (depends on the real-world that is being modeled by the relationship set).
- The following is possible mapping cardinality of relation R between two entity sets A and B (binary):
    - One-to-one (1:1): Women marrying Men (assuming no polygamy!)

    - Many-to-one (N:1): Children having mothers

    - one-to-many (1:N): Mothers having children

    - many-to-many (M:N): Students enrolled in courses

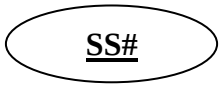
- A relationship may also have *descriptive attributes*:



(A relationship must be uniquely identified by the participating entities, without reference to descriptive attributes)

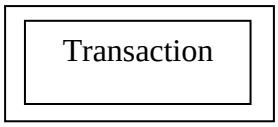
- Keys: Entities and relationships are distinguishable using various keys.
- Superkey: A combination of one or more attributes that allow us to identify uniquely an entity in an entity set (e.g., SS#, name & SS#).
- Candidate key: A minimal superkey (no proper subset is a superkey) that uniquely identifies an entity (e.g., SS#, name & address, phone#).

- Primary key: A candidate key chosen by DBA to identify entities of an entity set (e.g., SS#).



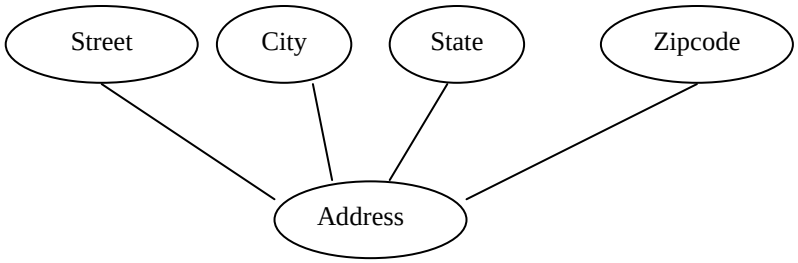
- Degree of relationship: Number of participating entity sets in a relationship.
    - Binary relationships: A relationship that involves two entities (e.g., enrolled)
    - Ternary (N-ary) relationships: A relationship that involves three (N) entities (e.g., Tony enrolled in csci-585 at USC)
- It is always possible to replace a non-binary relationship set by a number of distinct binary relationship sets (e.g., Tony enrolled in csci-585, csci-585 is-offered at USC). However, depending on the actual real-world problem, one may be more appropriate than the other.

- Weak entity set: An entity set that does not have enough attributes to form a primary key (e.g., transaction#, date, amount. Different accounts might have similar transaction#).

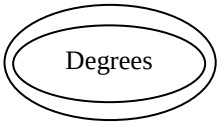


- Strong entity set: One with a primary key.
- How to distinguish entities of a weak entity set?
- Discriminator: Set of attributes in a weak entity set that allow distinguishing among all those entities in the entity set that depends on one particular strong entity (e.g. transaction# is unique within the same account#)

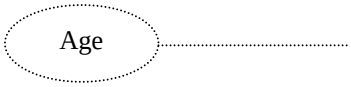
- Primary key of a weak entity set is formed by the primary key of the strong entity set on which it is existence-dependent (termed, *owner entity set*), plus it's discriminator (e.g., account#+transaction#).
- Attributes for relationships: Can be migrated to one of the participating entity sets for 1:1, 1:N and N:1 relationships (which one?). But NOT for M:N relationships.
- Attribute types:
  - **Composite** vs. simple: Useful when we sometimes need to refer to the entire attributes as a unit and sometimes to each of components:



  - **Multivalued** vs. single-valued: An attribute with a set of values for a same entity.



  - **Derived** vs. stored: The value of the attribute can be derived from either other attributes (e.g., age from DOB) or related entities (e.g., NumberOfEmployees).



  - **Null** attribute: When a value is ***not applicable*** for an attribute of a particular entity (e.g., AppartmentNumber, Degrees); or the value exists but is ***missing*** (e.g., null value for *Weight* of a person); or the value is ***not known*** to exist or not (e.g., null value for *phone#*).

(An interactive/attractive example ☺ here)