Entity Relationship Modelling

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Contents

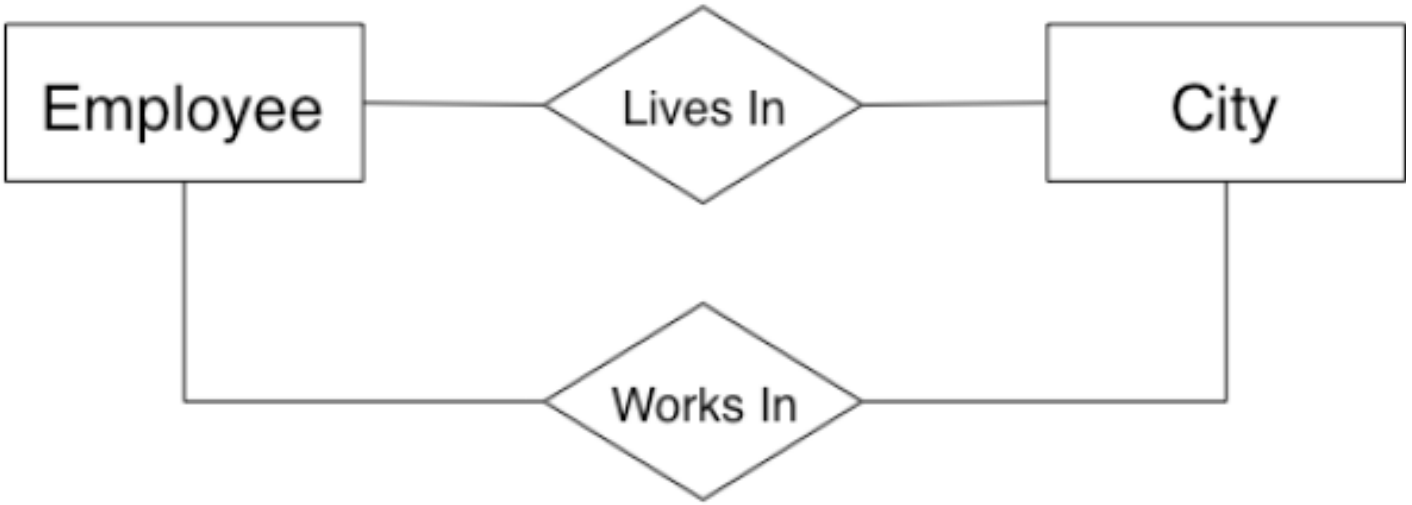
The Entity Relationship Model

- **Entity-Relationship Schema**
  - Describes data requirements for a new information system.
  - Direct, easy-to-understand graphical notation.
  - Translates readily to relational schema for database design.
    - But more abstract than relational schema
    - E.g. can represent an entity without knowing its properties

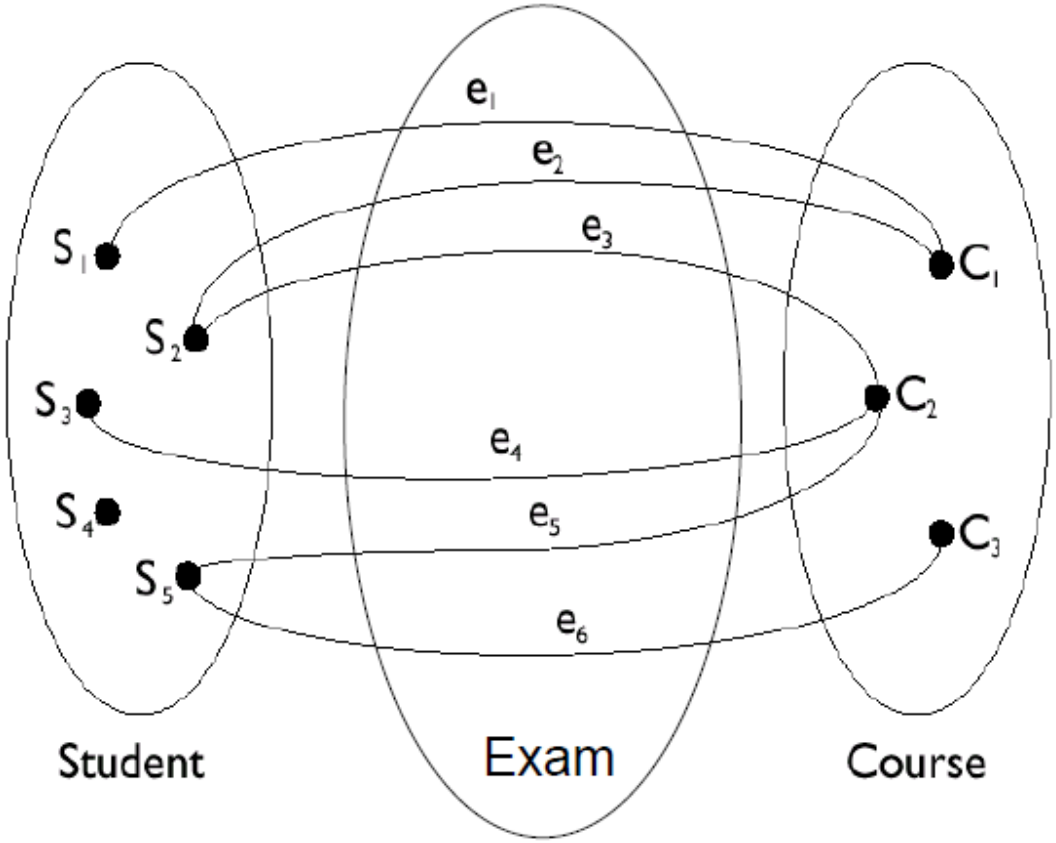
The Entity Relationship Model (cont.)

- **Entities**
  - Classes of objects with properties in common.
    - E.g. City, Department, Employee, Purchase and Sale
  - An instance of an entity is an object in the class represented by the entity.
    - E.g. Cantho, Travinh, are examples of instances of the entity City
- **Relationships**
  - Logical links between two or more entities.
    - E.g. Residence is a relationship that can exist between the City and Employee
  - An instance of a relationship is an n-tuple of instances of entities.
    - E.g. the pair (NguyenVanNam, Cantho), is an instance in the relationship Residence

Examples

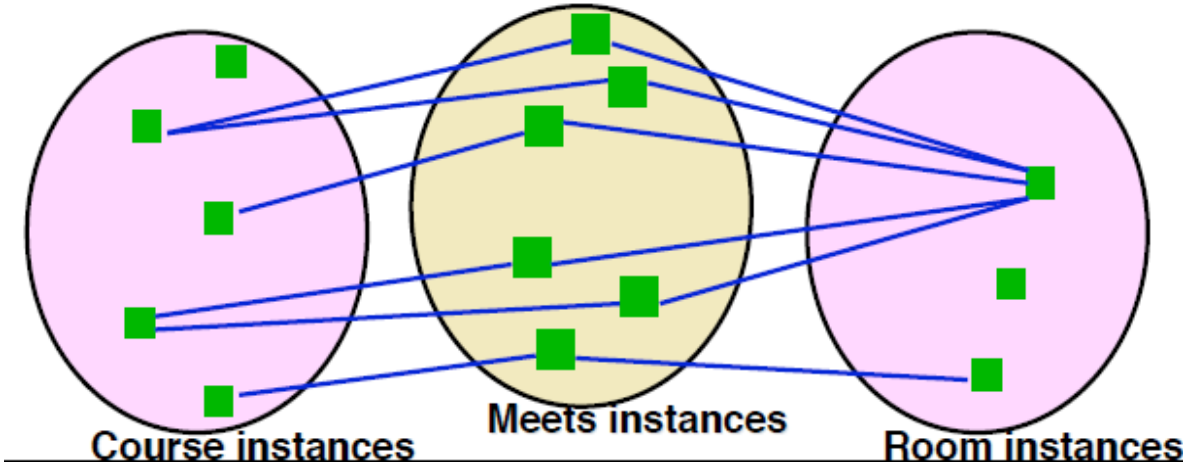


Example Instances for Exam



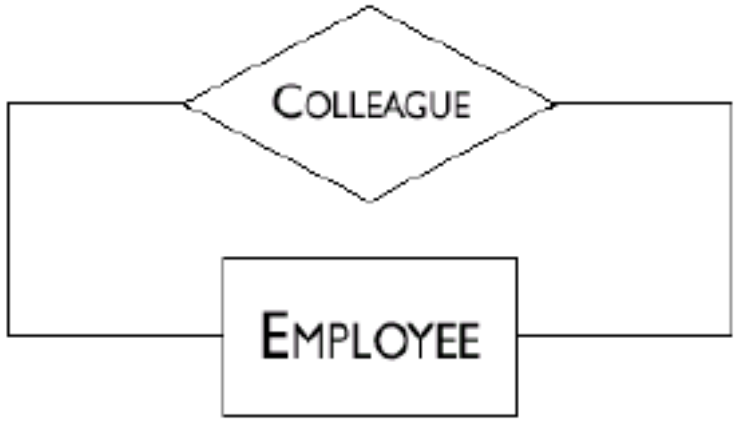
What Does An ER Diagram Really Mean?

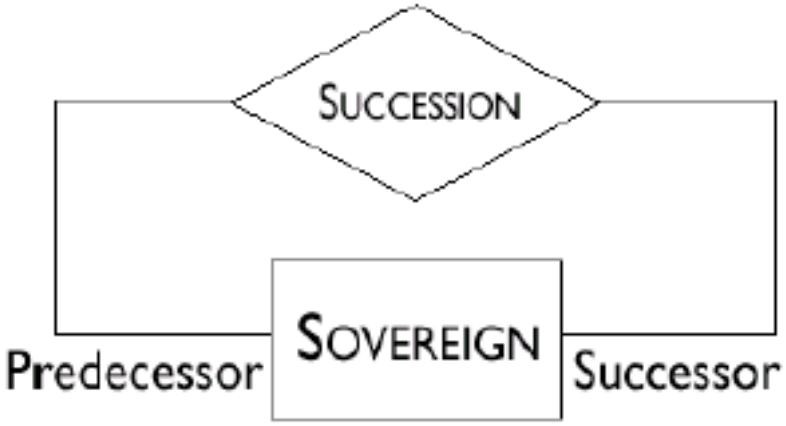
- **Course and Room are entities**
  - Their instances are particular courses (e.g. CT241) and rooms (e.g. 301/C1)
- **Meets is a relationship**
  - Its instances describe particular meetings.
  - Each meeting has exactly one associated course and room



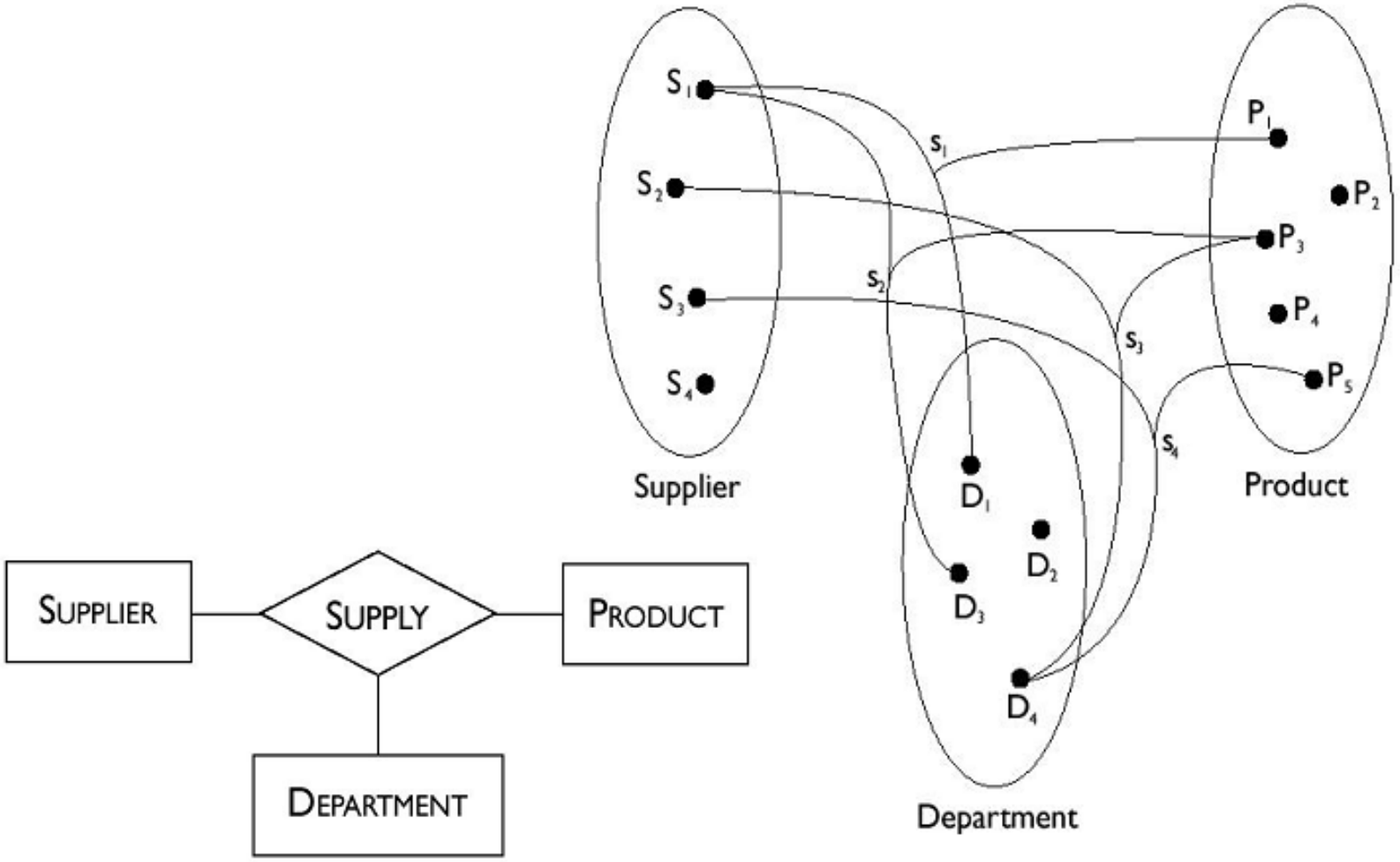
Recursive Relationships

- An entity can have relationships with itself…
- If the relationship is not symmetric…
  - …need to indicate the two roles that the entity plays in the relationship

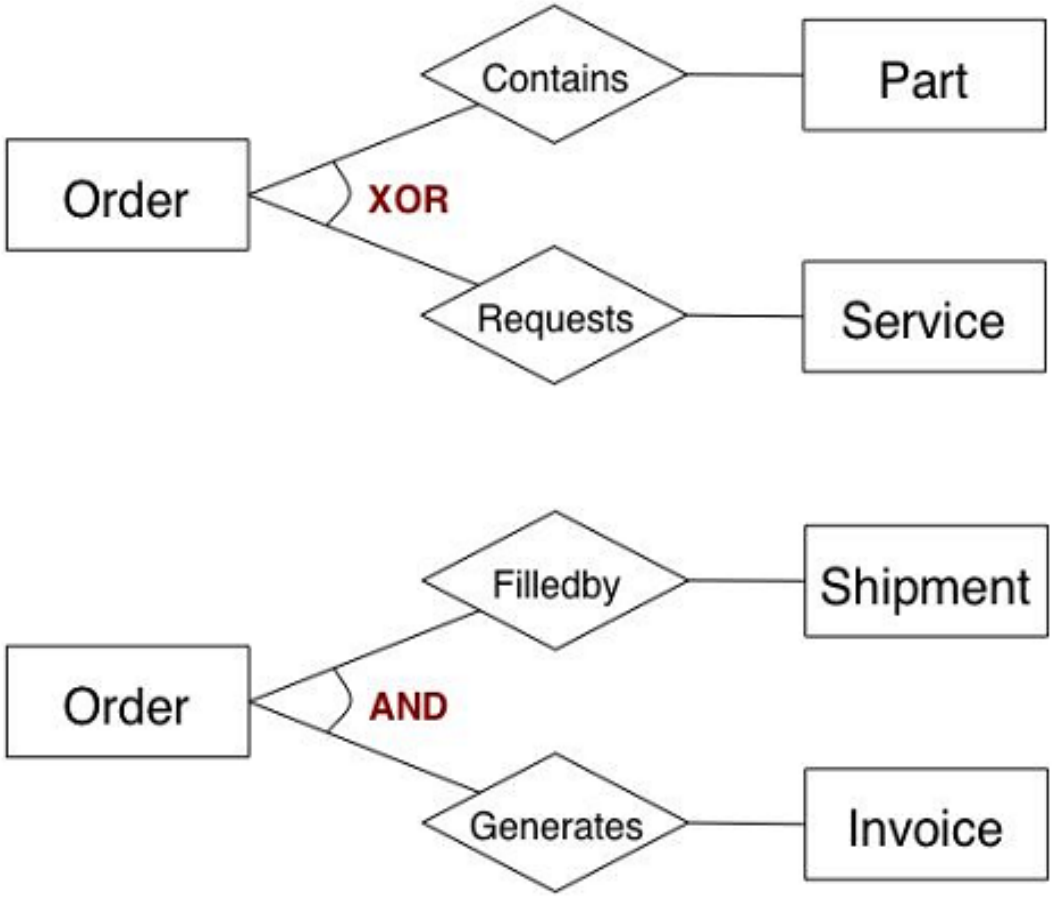




Ternary Relationships



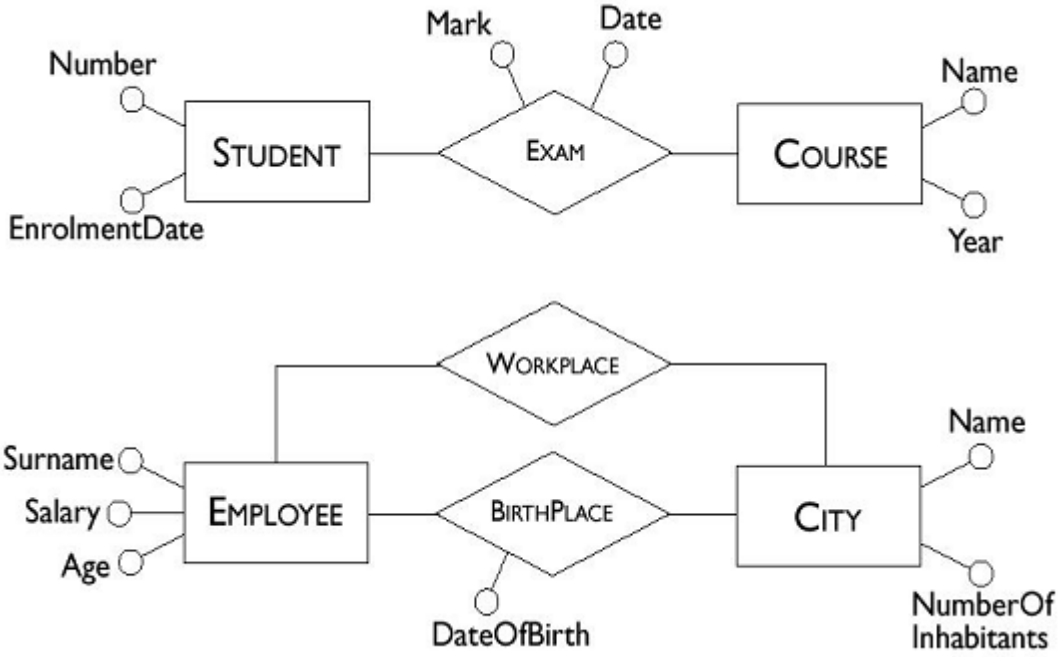
AND/XOR Relationships



- "Each Order either contains a part or requests a service, but not both"
- "For any given order, whenever there is at least one invoice there is also at least one shipment and vice versa"

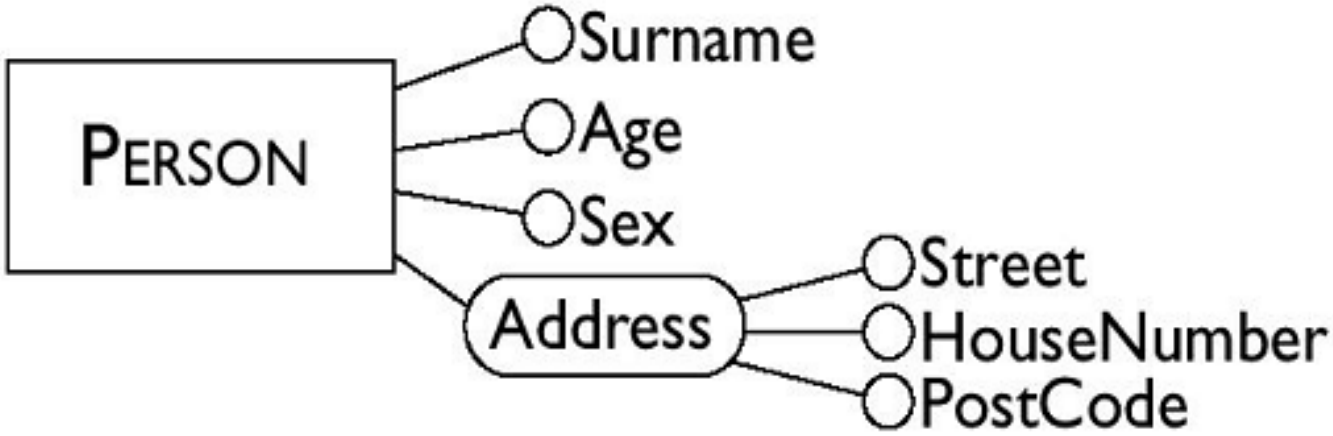
Attributes

- Associates with each instance of an entity (or relationship) a value belonging to a set (the domain of the attribute).
  - The domain determines the allowed values for the attribute.

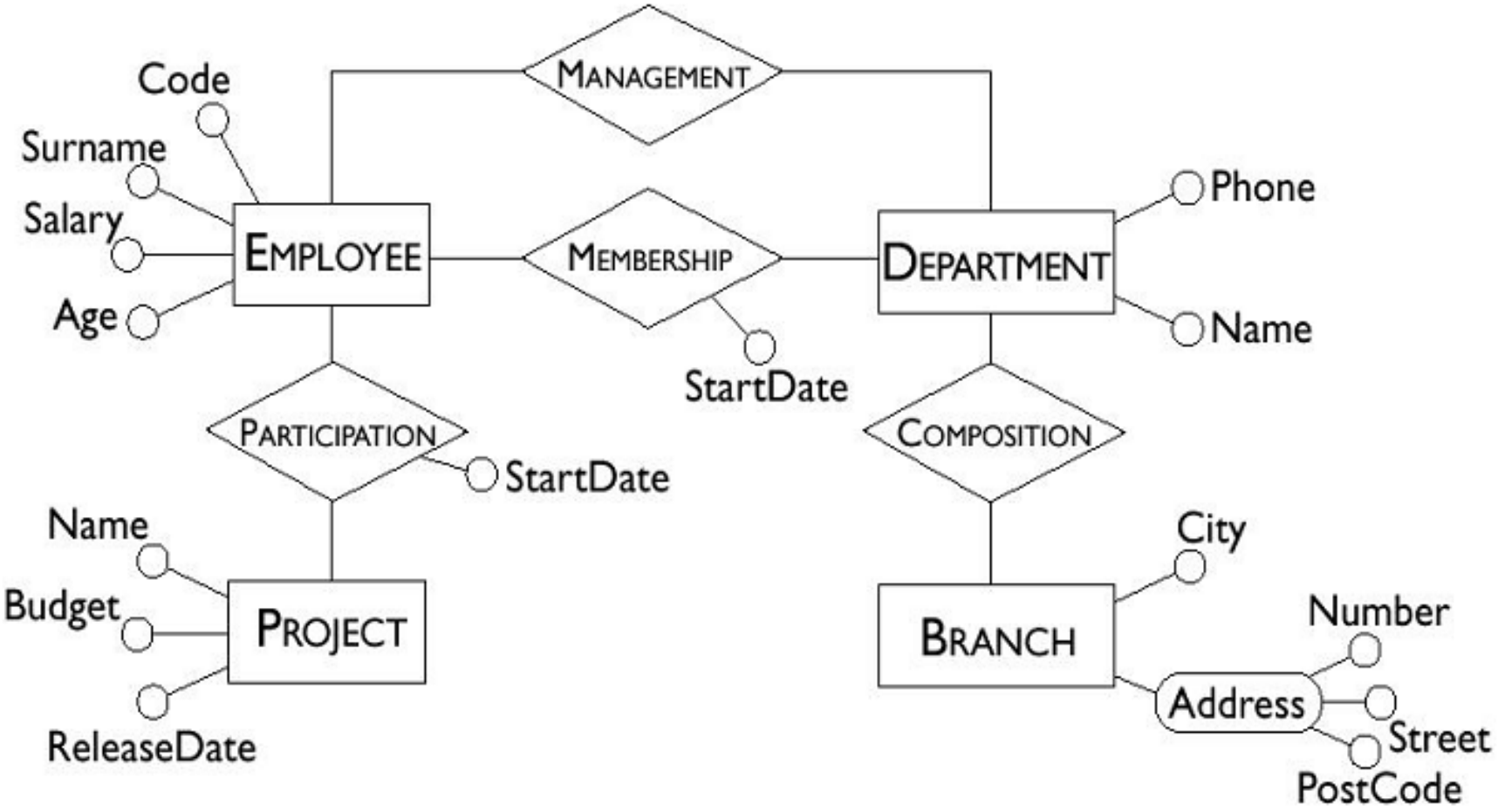


Composite Attributes

- A group attributes of the same entity or relationship that have closely connected meanings or uses



Schema with Attributes



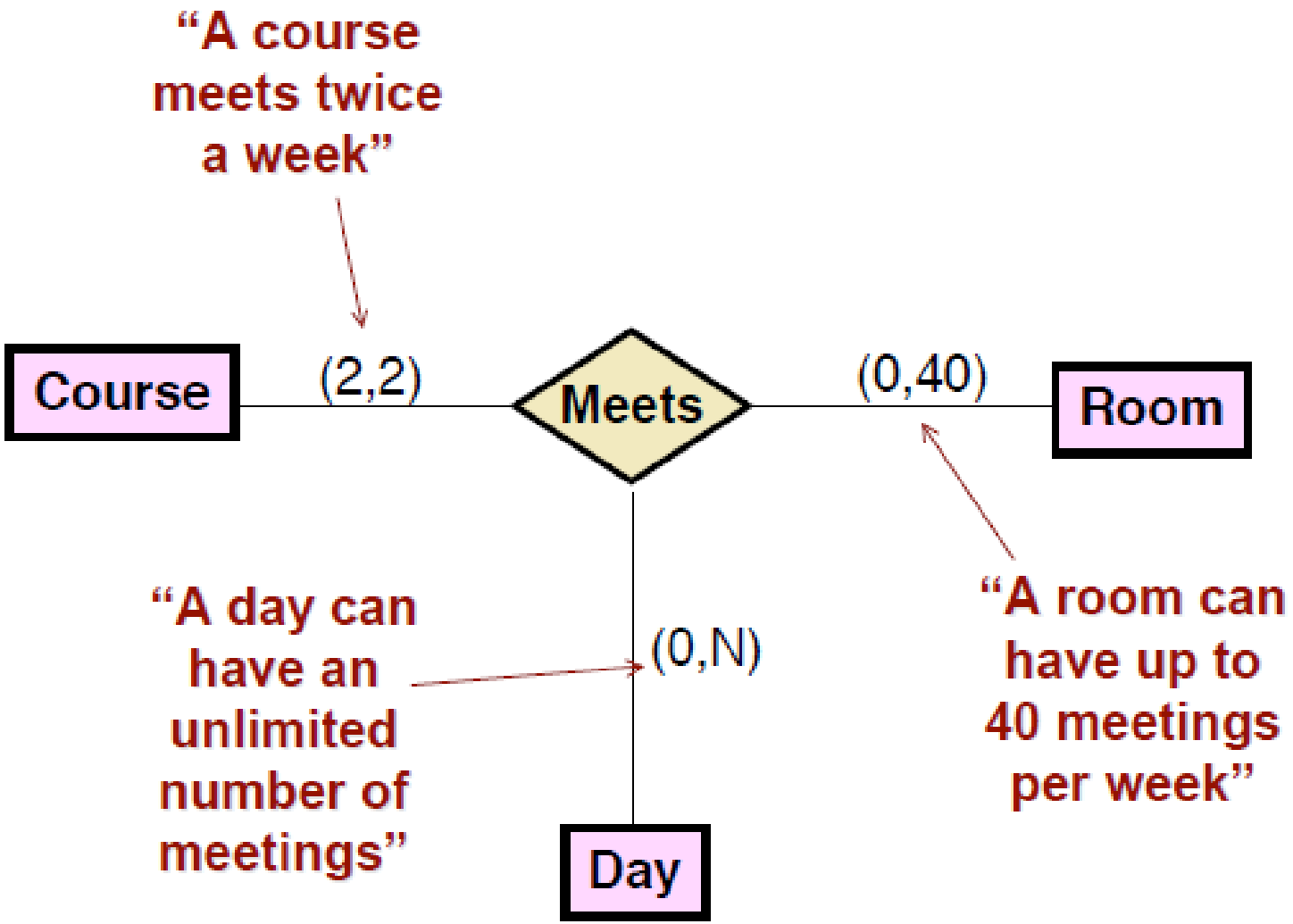
Cardinalities

- Cardinalities constrain participation in relationships.
  - Maximum and minimum number of relationship instances in which an entity instance can participate.
  - E.g.

Cardinalities (cont.)

- Cardinality is any pair of non-negative integers (a, b)
  - Such that $a \leq b$
  - If $a=0$ then entity participation in a relationship is optional.
  - If $a=1$ then entity participation in a relationship is mandatory.
  - If $b=1$ each instance of the entity is associated at most with a single instance of the relationship.
  - If b="N" each instance of the entity is associated with an arbitrary number of instances of the relationship.

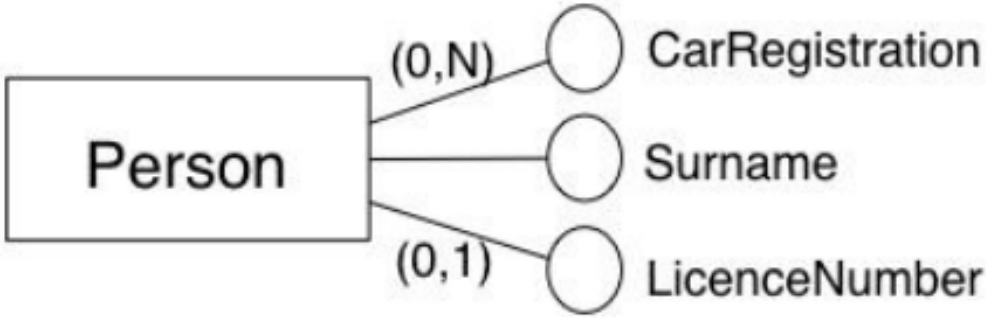
Cardinality Example

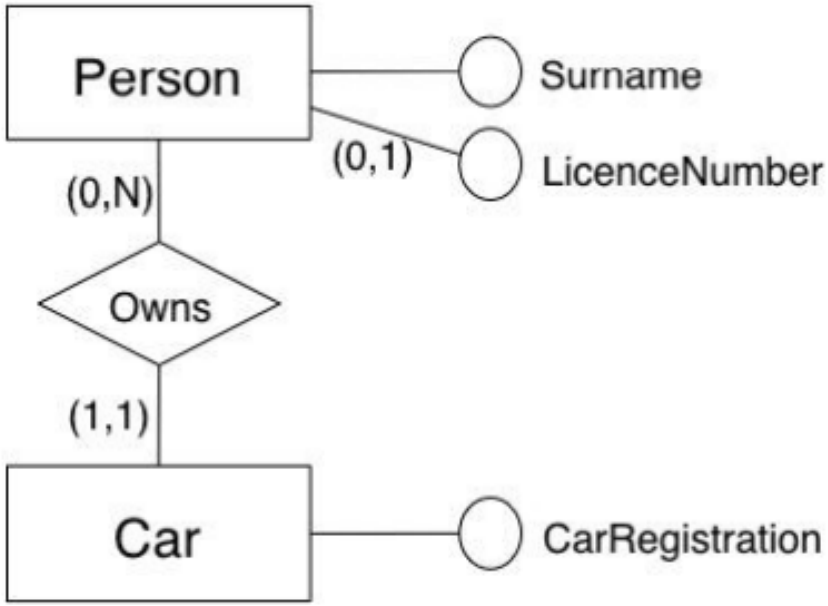


Cardinalities of Attributes

- Attributes can also have cardinalities
  - To describe the minimum and maximum number of values of the attribute associated with each instance of an entity or a relationship.
  - The default is (1, 1)
  - Optional attributes have cardinality (0,1)
- Multi-valued attribute cardinalities are problematic
  - Usually better modelled with additional entities linked by one-to-many (or many-to-many) relationships.

Cardinalities of Attributes (cont.)

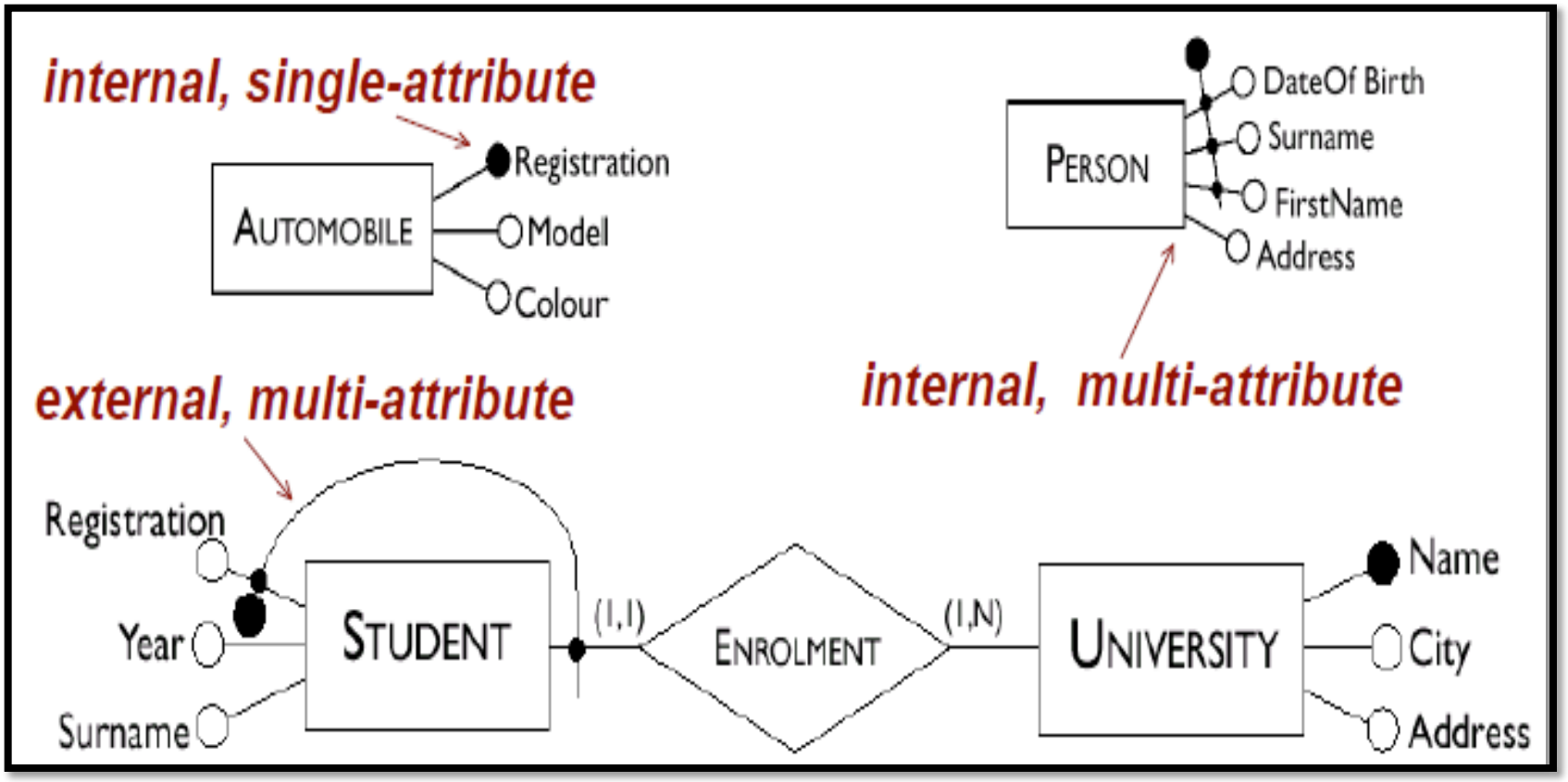




Identifiers

- How to uniquely identify instances of an entity?
  - An identifier may formed by one or more attributes of the entity itself.
  - If attributes of an entity are not sufficient to identify instances unambiguously, other entities can be involved in the identification.
  - A relationship is identified using identifiers for all the entities it relates.
    - E.g. the identifier for the relationship (Person-) Owns(-Car) is a combination of the Person and Car identifiers

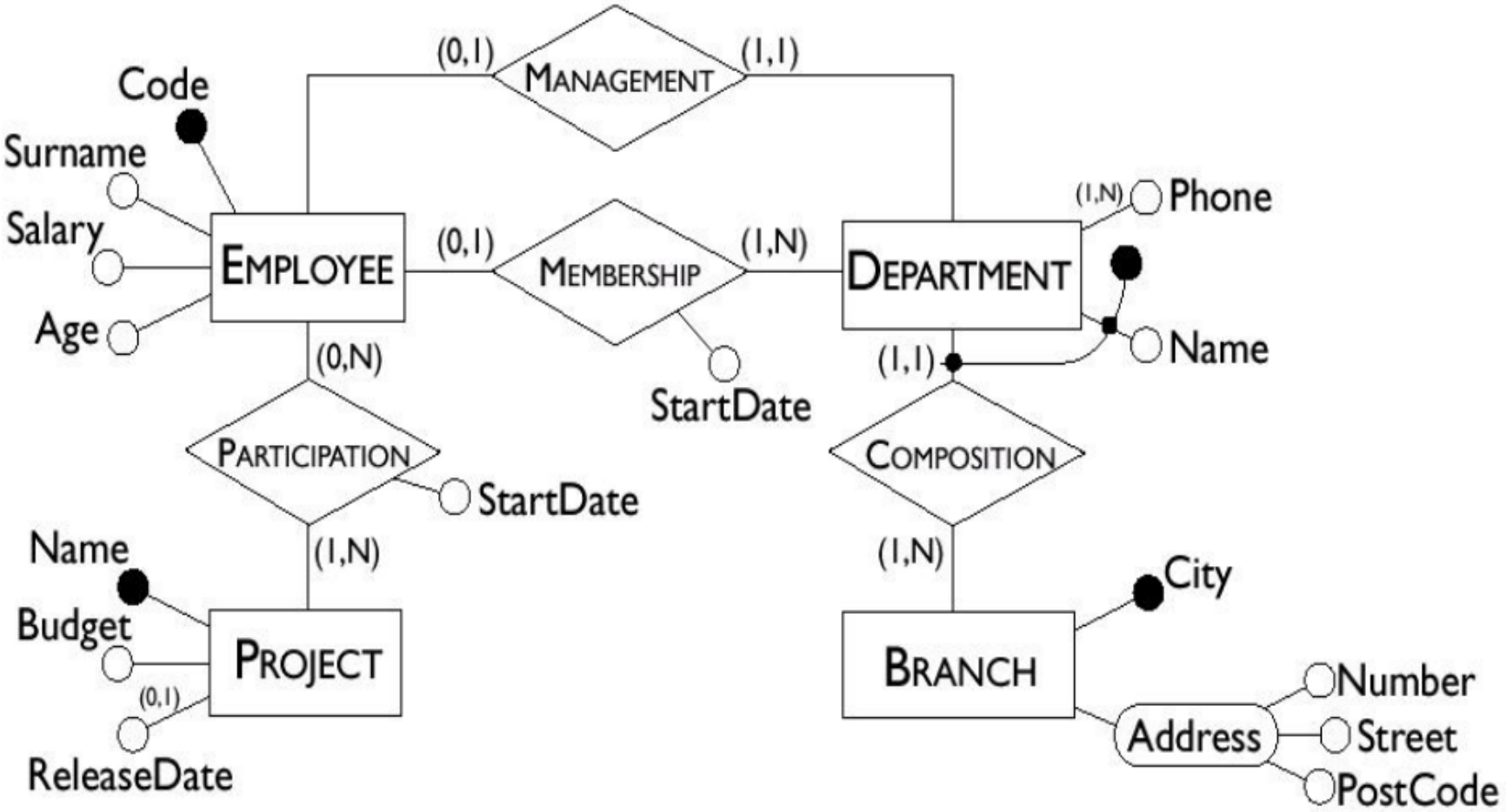
Identifiers (cont.)



Notes on Identifiers

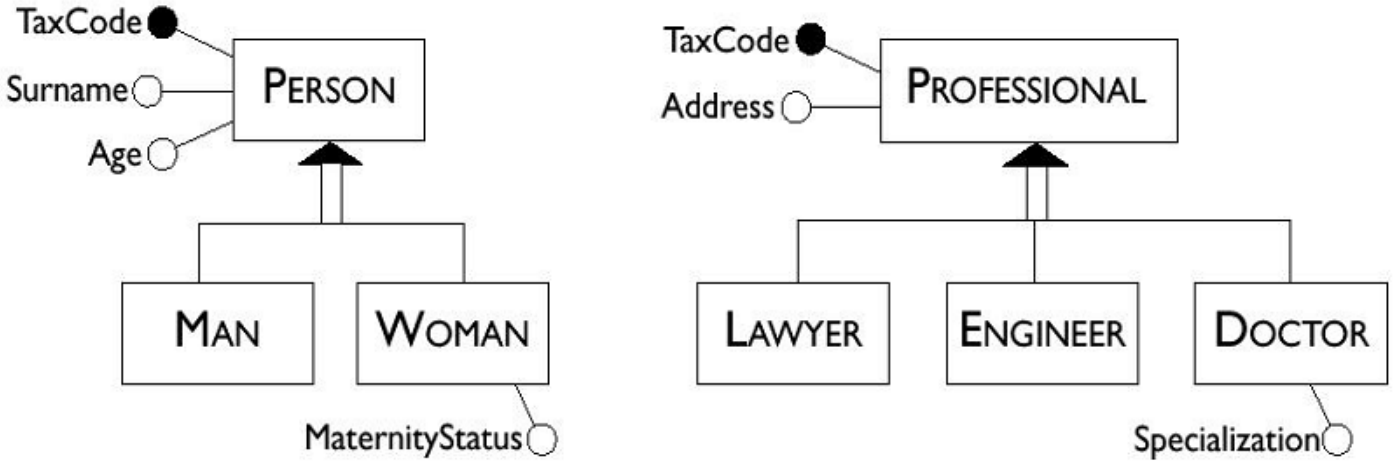
- Identifiers and cardinality
  - An identifier can involve one or more attributes, provided that each has (1,1) cardinality.
  - An external identifier can involve one or more entities, provided that each is a member of a relationship to which the entity to identify participates with cardinality (1,1).
- Multiple identifiers
  - Each entity must have at least one (internal or external) identifier.
  - An entity can have more than one identifier.

Schema with Identifiers



Generalizations

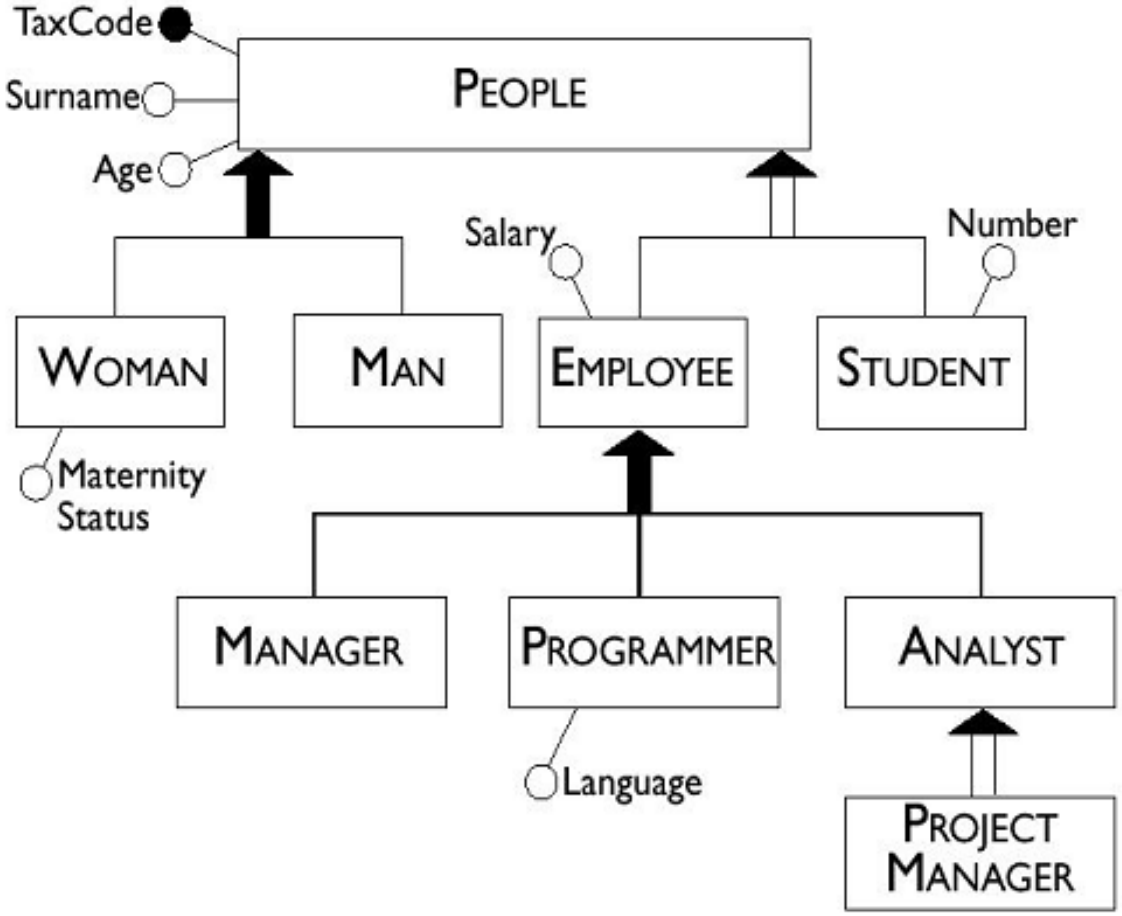
- Show "is-a" relationships between entities



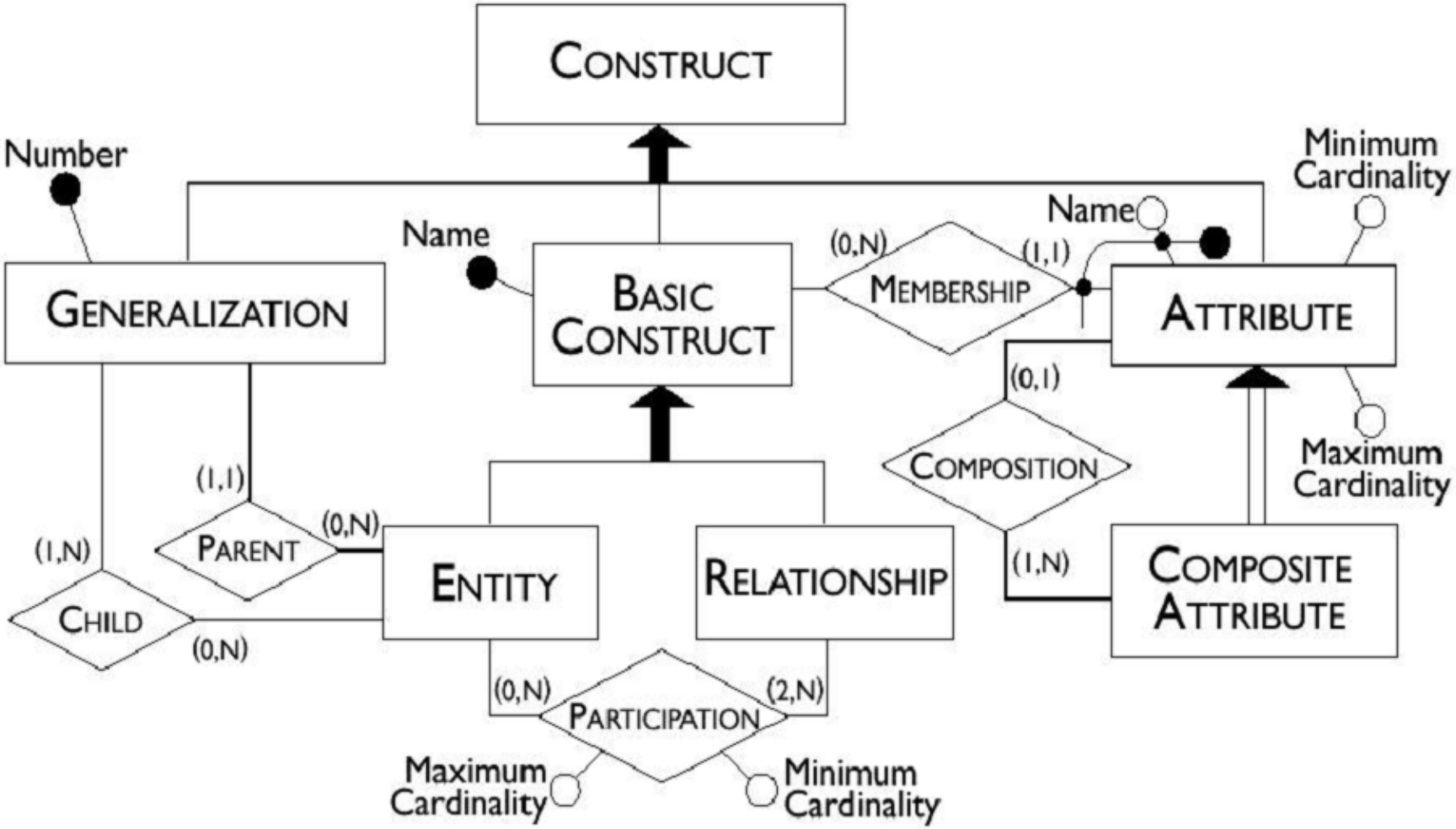
- Inheritance:
  - Every instance of a child entity is also an instance of the parent entity.
  - Every property of the parent entity (attribute, identifier, relationship or other generalization) is also a property of a child entity.

Types of Generalizations

- Total generalizations
  - …every instance of the parent entity is an instance of one of its children.
  - Shown as a solid arrow.
- Exclusive generalizations
  - …every instance of the parent entity is at most an instance of one of its children



The E-R Meta-Model



Main references

- **Prof Steve Easterbrook, lecture notes, University of Toronto, Canada.**

Q&A