Entity-relationship model

Jaroslav Porubän, Miroslav Biňas, Milan Nosáľ (c) 2011 - 2016

Entity-relationship (ER) model

- **Conceptual** data model
- Considering the world as a set of objects called **entities** and **relationships** between these objects
- Used for graphical modelling of data structure in the domain - objects and their relationships

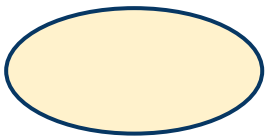
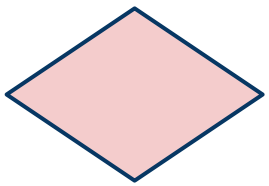
Basic terminology I.

- **Entity**
  - Existing object that can be differentiated from other objects - can be identified
  - e.g.: `John Doe`, `Joseph Smith`
- **Entity type**
  - Set of entities that have the same type
  - e.g.: `Student`, `Course`, `City`, `Book`
- **Attribute**
  - Property of entity type; entity type is a set of attributes
  - e.g.: `birthday`, `age`, `name`
  - **Domain** - set of possible values

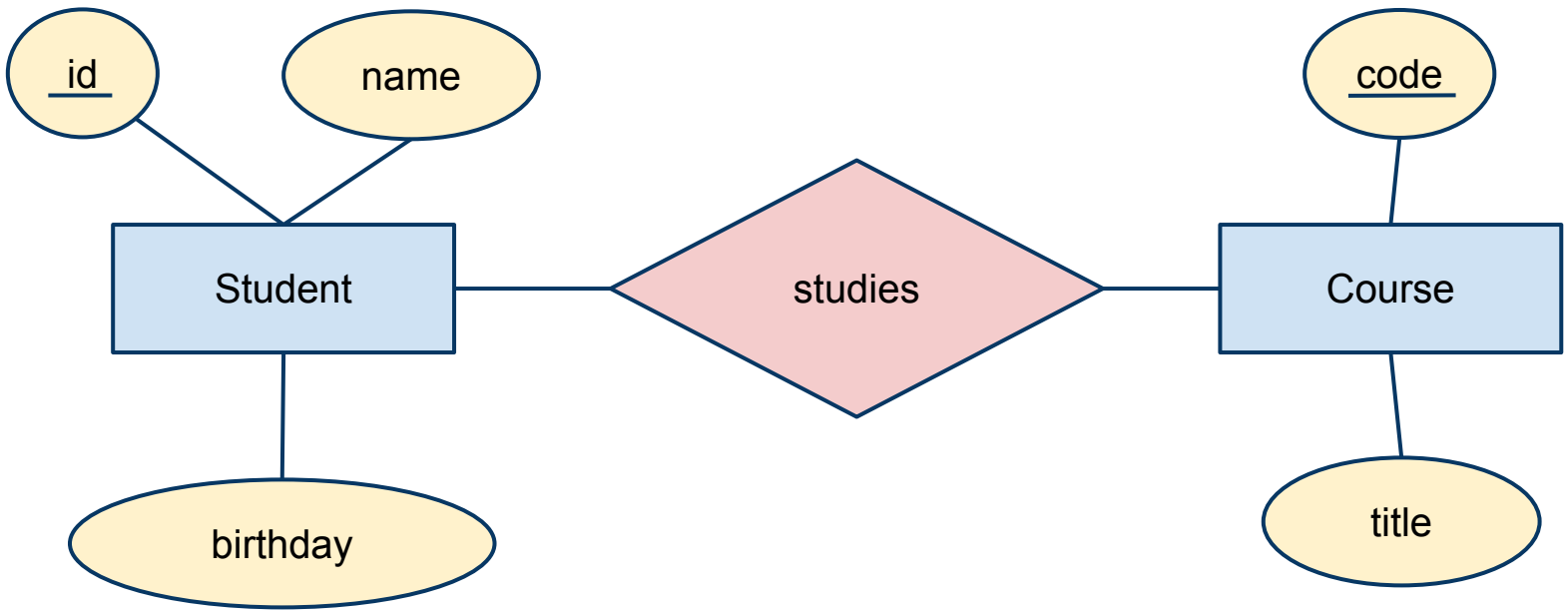
Basic terminology II.

- **Relationship**
  - Relationship between entities
- **Relationship type**
  - Mathematical relation over a entity types
  - e.g.: `teaches` (relationships between `Teacher` and `Student` entites)
  - Attribute can belong to a relationship type as well (e.g., a year when a particular teacher started to teach a particular student)

Entity-relationship diagram (ERD)

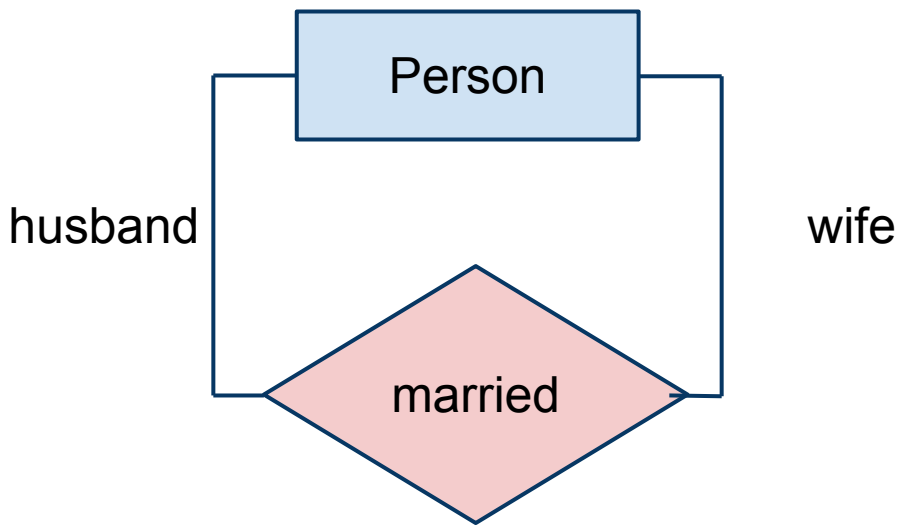
- **ERD** is a graphical tool for expressing ER model (has multiple notations)
- Basic building blocks of ERD:
  - Entity type 
  - Attribute 
  - Relationship type 
  - Connection

ERD example



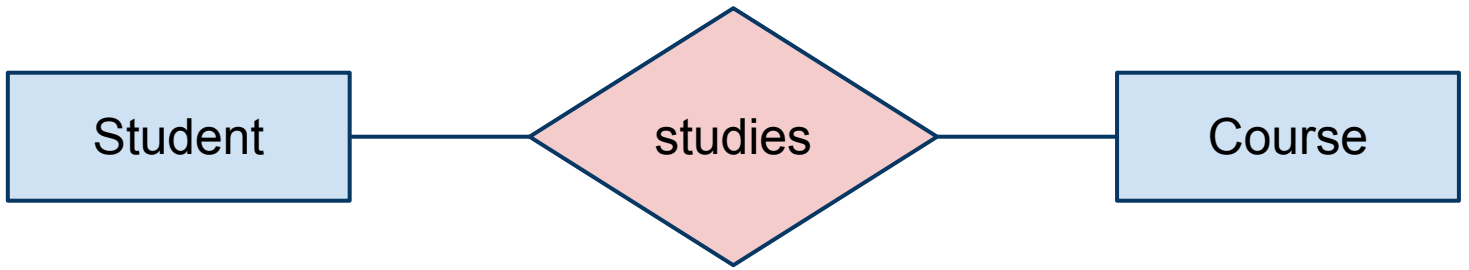
Relationship properties - Relationship degree I.

- **Degree** - number of participating entity types
  - Recursive (unary)

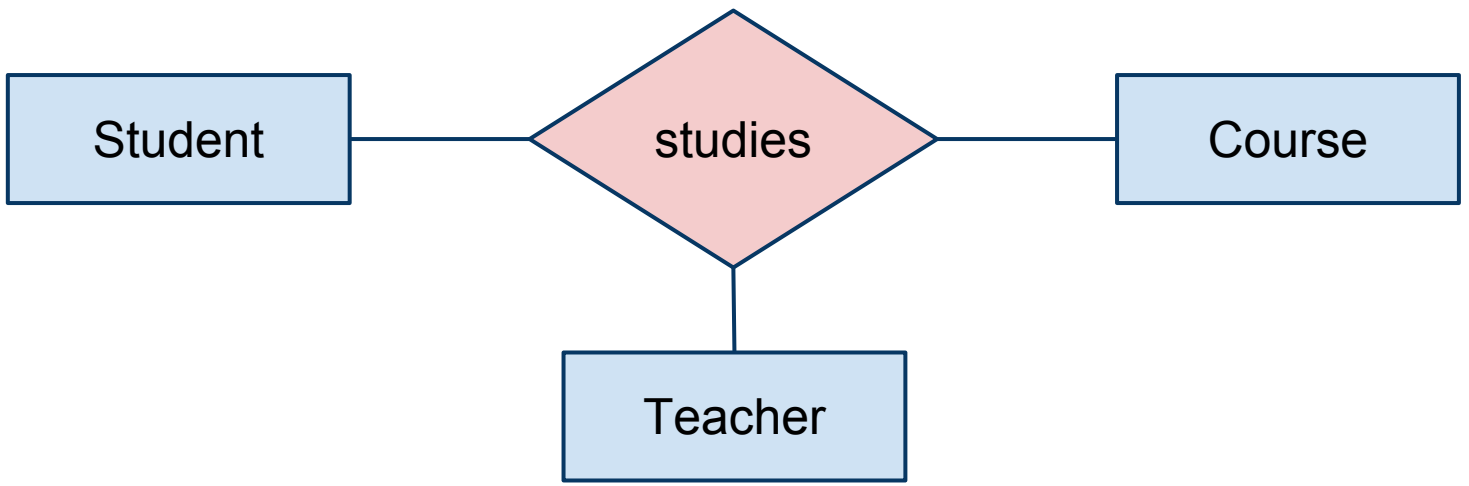


Relationship properties - Relationship degree II.

- Binary (most common)

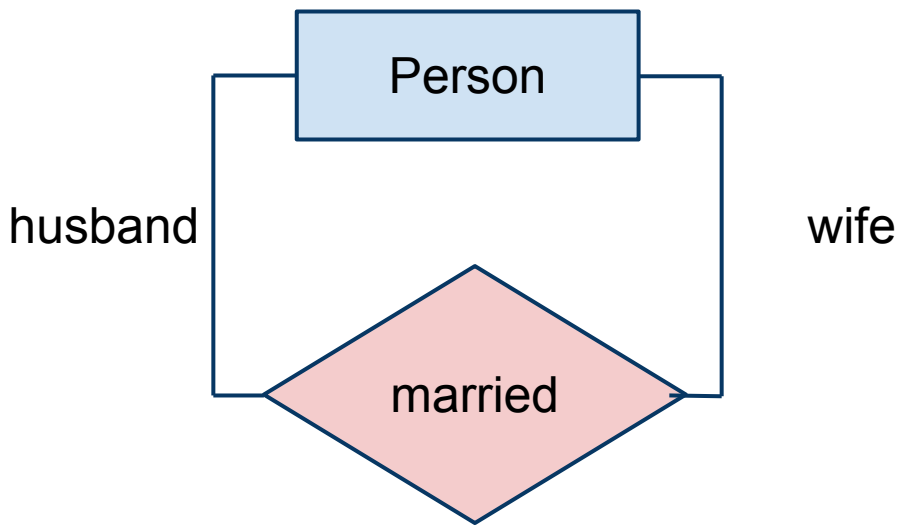


- Ternary (rarely used)



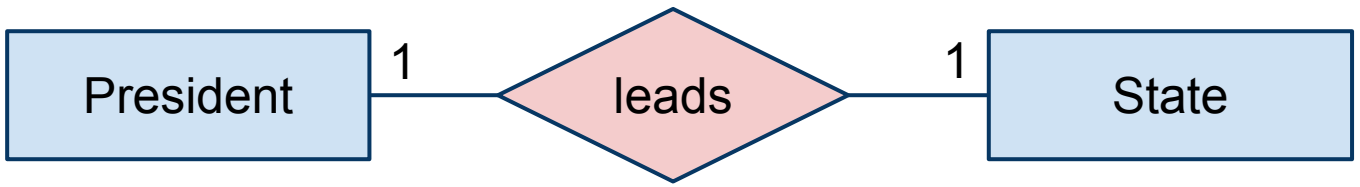
Relationship roles

- Each entity type plays a role in relationship
  - Roles allow to differentiate mutliple occurences of the same entity type

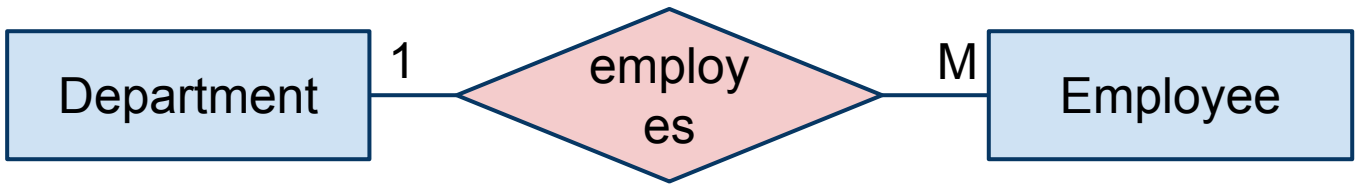


Relationship cardinality

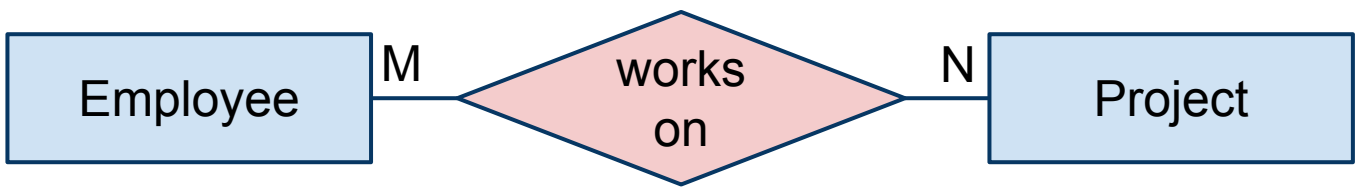
- 1:1 (One-to-One)



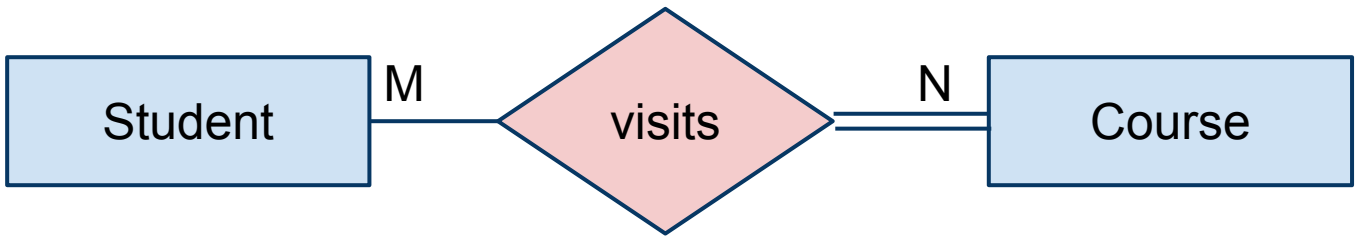
- 1:N (One-to-Many), N:1 (Many-to-One)



- M:N (Many-to-Many)

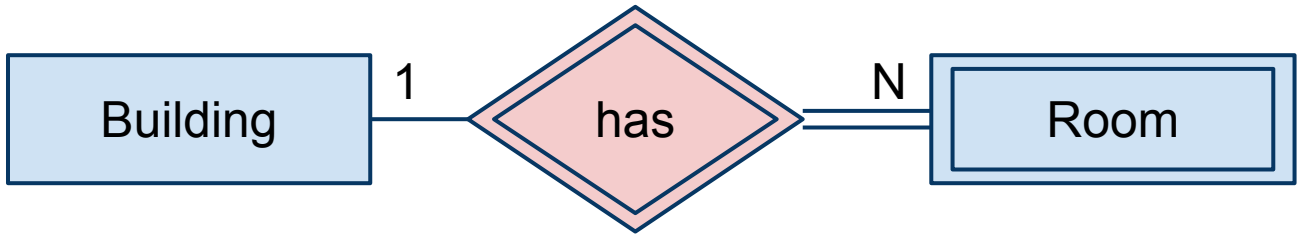


Participation in relationship



- Entity type with partial participation - `Student`
  - Student does not have to visit a course
- Entity type with total participation - `Course`
  - If there is no student that visits a course, it cannot be provided (course without student cannot exist)
  - Every course entity has to be in relationship with at least one student

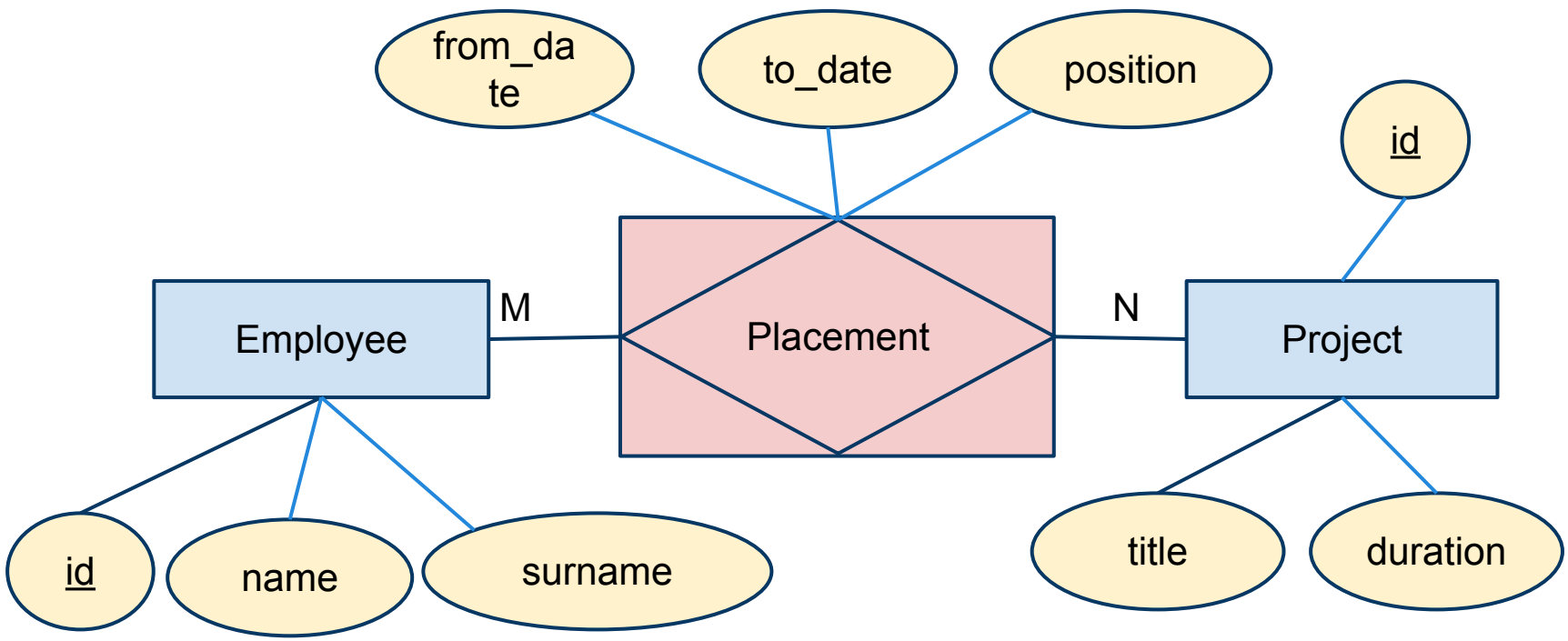
Weak entity types



- Weak entity type does not have primary key on its own - it is identified by relationship's strong entity type (identifying entity type)
  - Discriminator (partial key) of weak entity type is a set of attributes that differentiates between weak entities belonging to the same strong entity
  - Room's primary key is combination of primary key of corresponding building (e.g., address) and discriminator of room (e.g., room number)

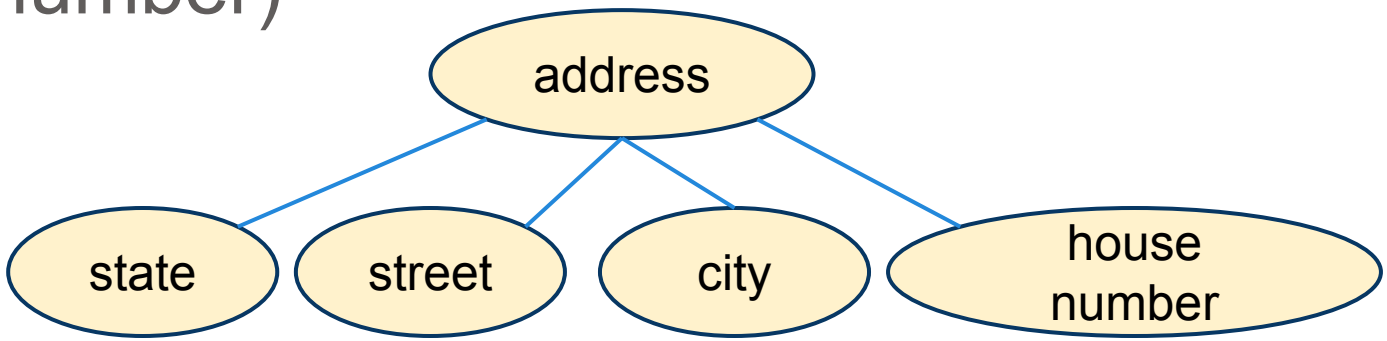
Associative entity type

- Entity type used as relationship type - association (relationship type with attributes)

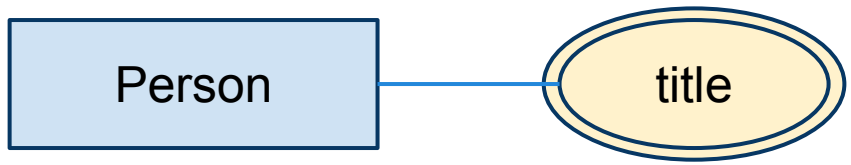


Attribute properties I.

- **Simple** and **composed**
  - Address (state, city, street, house number)

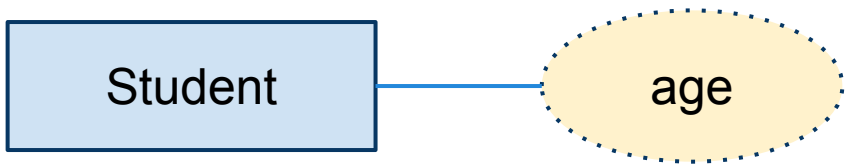


- **Single-valued** and **multiple-valued**
  - Title (Assoc. prof., Ing., PhD.)



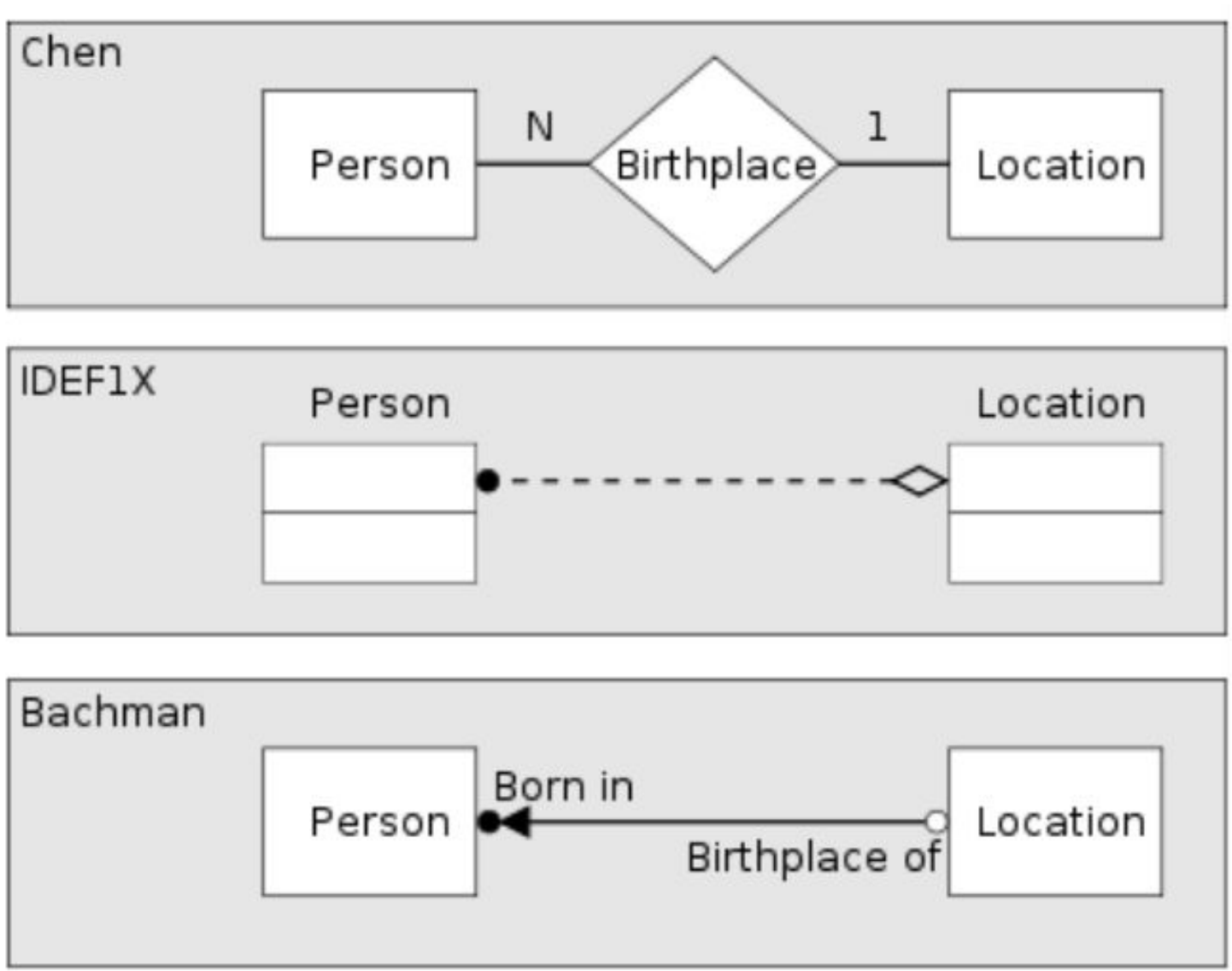
Attribute properties II.

- **persistent** and **derived**
  - birthday vs. age



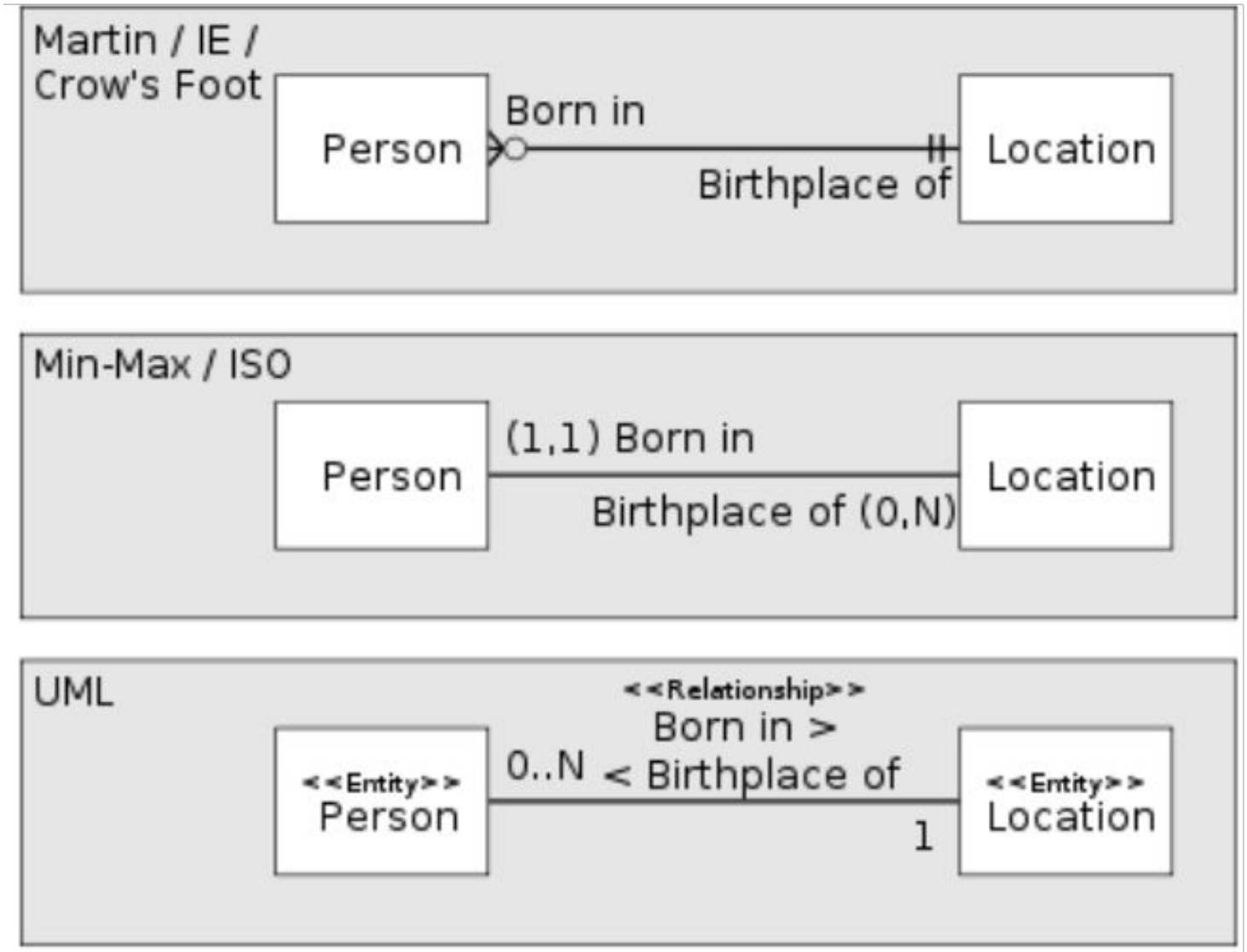
- **`NULL` value**
  - Special attribute value (unknown (yet), or not applicable)
  - e.g.: telephone number (if the person does not have one, or does not want to share it, we will use `NULL`)

ERD Notations I.



Zdroj: http://en.wikipedia.org/wiki/Entity-relationship

ERD Notations II.



Zdroj: http://en.wikipedia.org/wiki/Entity-relationship

Výhody ER modelovania

- Separation of data and activities
- Easily understandable graphical notation for database design
  - Small set of concepts
  - Easily learnable
- Representation of real world objects and their structure
- Straightforward conversion to relational model

Questions?