The Entity-Relationship Model

Olaf Hartig

David R. Cheriton School of Computer Science
University of Waterloo

CS 640
Principles of Database Management and Use
Winter 2013

These slides are based on a slide set provided by Prof. M. Tamer Özsu.

Notes

Outline

Notes

Overview of the E-R Model

- Proposed by Peter Chen in 1976
- Used for designing the conceptual schema for a database

- Relevant parts of the world/enterprise described in terms of:
  - entities,
  - attributes, and
  - relationships.

- Graphical presentation: E-R diagram
- Many variant notations and extensions are in common use
  - e.g. Teorey et al.'s EER model (as discussed next week)

Notes

Entities and Entity Sets

Entity: a *distinguishable* object

Entity set: set of entities of same type
Examples:

- students currently at University of Waterloo
- flights offered by Air Canada
- burglaries in Ontario during 1994

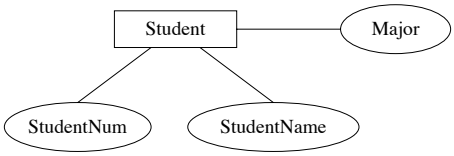
Graphical representation of entity sets:

Notes

Attributes

Attributes: describe properties of entities

All entities in an entity set have the same set of attributes.



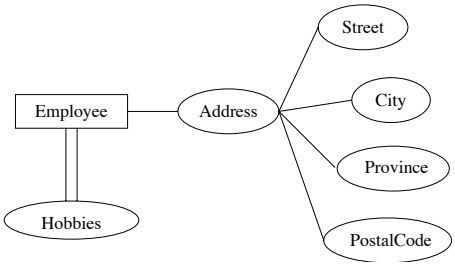
Domain: set of permitted values for an attribute

Note
What is an attribute in one application, can be an entity in another.

Notes

Types of Attributes

Basic attributes: have an atomic value (e.g. an integer, a color name)
Composite attributes: composed of other attributes (e.g. an address)
Multivalued attributes: attributes that are set-valued (e.g. hobbies)



Notes

Relationships and Relationship Sets

Relationship: representation of the fact that certain entities are related to each other

Example:

- student Bob is registered in course CS 640

Relationship set: set of relationships of a given type

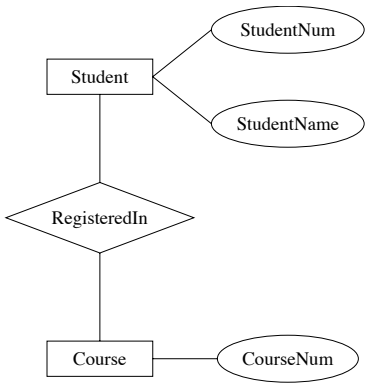
Examples:

- students registered in courses
- passengers booked on flights
- parents and their children
- bank branches, customers and their accounts

Degree: number of participating entities / entity sets

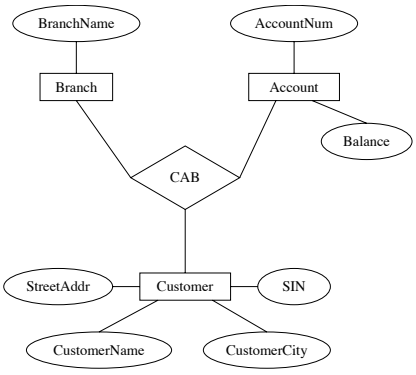
Notes

Relationships and Relationship Sets (cont'd)



Notes

Relationships and Relationship Sets (cont'd)

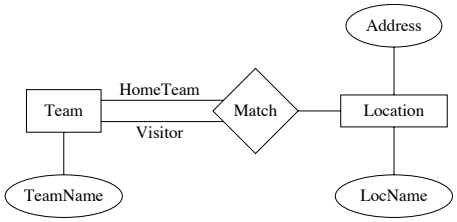


Notes

Roles

Role: the function of an entity set in a relationship set

Role name: an explicit indication of a role



Attention

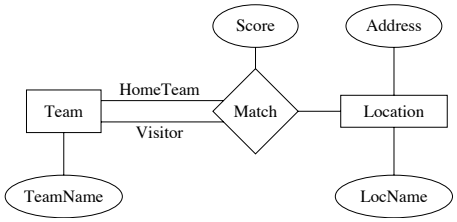
Role labels are needed whenever an entity set has multiple functions in a relationship set.

Notes

Relationships and Attributes

Note

Relationships may also have attributes.



Notes

Additional Features

- Keys
- Cardinality constraints
- Weak entities

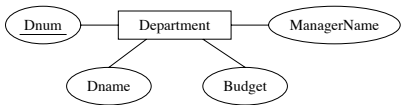
Notes

Keys

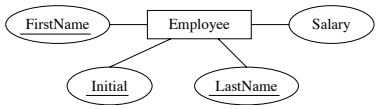
Entities in an entity set must be distinguishable from one another.

Key: set of attributes such that each entity has a unique combination of values for these attributes (among all other entities in the set)

Example 1:



Example 2:



Notes

Types of (Binary) Relationship Sets

many-to-many (N:N): an entity in one set can be related to many entities in the other set, and vice versa
(This is the interpretation we have used so far.)

many-to-one (N:1): each entity in one set can be related to at most one entity in the other, but an entity in the second set may be related to many entities in the first

one-to-many (1:N): vice versa

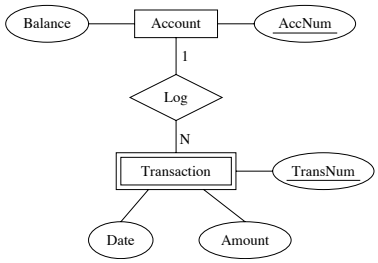
one-to-one (1:1): each entity in one set can be related to at most one entity in the other, and vice versa

Notes

Weak Entities

Sometimes the existence of an entity depends on the existence of another entity

Weak Entity: can be identified uniquely only by considering another entity (called *owner entity*)



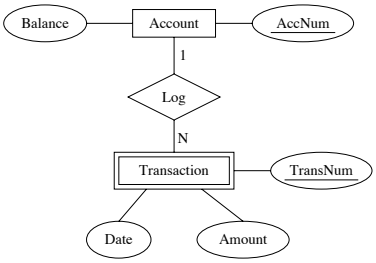
Notes

Weak Entities (cont'd)

Attributes of a weak entity only form key relative to the owner entity.

Discriminator: set of attributes that distinguish weak entities associated with a *particular* owner entity

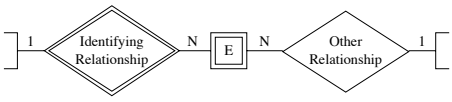
Key: discriminator + key of the owner entity set



Notes

Weak Entities (cont'd)

- A weak entity set must have a many-to-one (identifying) relationship to a distinct entity set (the *owner entity set*).
- Visually distinguishing an identifying relationship set:



Notes

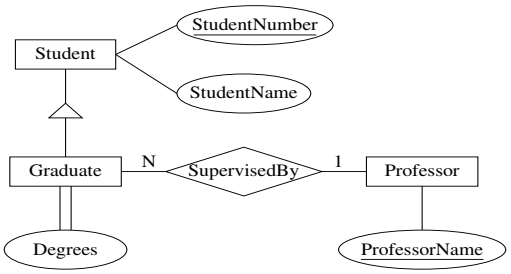
Extensions to the E-R Models

- Specialization / Generalization
- Participation constraints
  - see Teorey et al.
- etc.

Notes

Specialization

A specialized kind of entity set may be derived from a given entity set

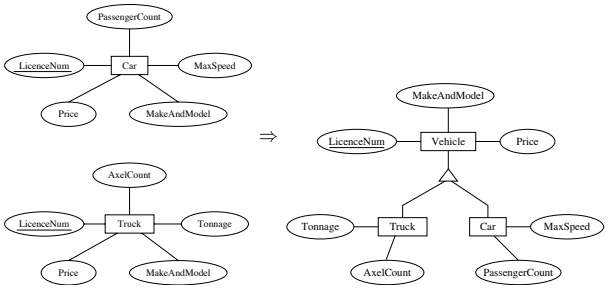


Key is always only given for the general entity set

Notes

Generalization

Several entity sets can be abstracted by a more general entity set



Notes

Constraints for Specializations

disjoint entities of the general set belong to *at most* one special set

- e.g. every vehicle is either a truck or a car (not both)

vs.

overlapping entities of the general set *may* belong to more than one special set

- e.g. some vehicles may be truck and car (to accommodate utility vehicles, perhaps)

---

complete entities of the general set must belong to a special set

- e.g. every vehicle is also a truck or a car (or both)

vs.

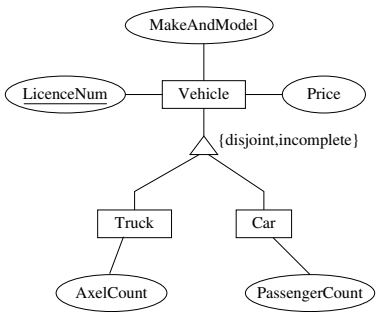
incomplete entities of the general set need not belong to a special set

- e.g. some vehicles may neither be a truck nor a car

Notes

Constraints for Specializations (cont'd)

A possible graphical representation:



Notes

Designing an E-R Model

In our discussion next week ...

Read:

- I.-Y. Song and K. Froehlich: **Entity-Relationship Modeling: A Practical How-to Guide**. *IEEE Potentials 13*(5): 29-45 (1994-1995).
- T. J. Teorey, D. Yang, and J. P. Fry: **A logical design methodology for relational databases using the extended entity-relationship model**. *ACM Computing Surveys 18*(2): 197-222 (1986).

  (see Web page)

Notes

Notes