Object modeling

Graphical notations for conceptual modeling

ER (1976)
Entity-Relationship diagrams

OMT (1991)
Object Modelling Technique diagrams

UML (1994)
Simplified Unified Modelling Language object class diagrams

and many many, … other graphical notations

Basic concepts

Database is quantised into discrete objects

Objects are described by attributes (properties) and operations (methods) (*We shall ignore operations*)

Values of selected attributes (identifier) identify objects

Class of objects is a a group of homogeneous objects with common properties, common semantics, and common identifiers

Examples

A student is an object, a lecturer is an object, a lecture hall is an object, a shipment is an object, an accident is an object, …
A student is described by the attributes like: student number, first name, last name, date of birth, …
A student is identified by student number, a lecture hall is identified by building number and room number, a shipment is identified by a supplier name, date, and time, …
A group of students forms a class STUDENT, a group of lecturers forms a class LECTURER, …

Basic concepts

Link is a conceptual connection between two or more objects

Association represents a group of homogeneous links with a common structure, common attributes, common semantics, and common identifiers

Examples

Sample links:
James talks to Janusz
Lecture 1 in CSCI235 is-in building 3 room 2

Peter supplies bolts to James

Sample associations:
STUDENT Talks-to LECTURER

LECTURE Is-in BUILDING

SUPPLIER Supplies PART To MANUFACTURER

Basic concepts

Generalization hierarchy represents Is-a-subset relation between the classes of objects

If a set of all objects in a class X is a subset of a set of all a objects in a class Y then class Y is a generalization of class X

In the other words, if a class Y is a generalization of class X then a set of all objects in Y includes a set of all objects in X

Examples

A class STUDENT is a generalization of classes UNDERGRADUATE STUDENT and POSTGRADUATE STUDENT
It is so because a set of all undergraduate students is a subset of a set of all students and …
… a set of all postgraduate students is a subset of a set of all students
In the other words, a set of all students includes a set of all postgraduate students and it also includes a set of all undergraduate students

Examples

A class HUMAN is a generalization of classes STUDENT and LECTURER

It is so because a set of all students is a subset of a set of all humans and …
… a set of all lecturers is a subset of a set of all humans

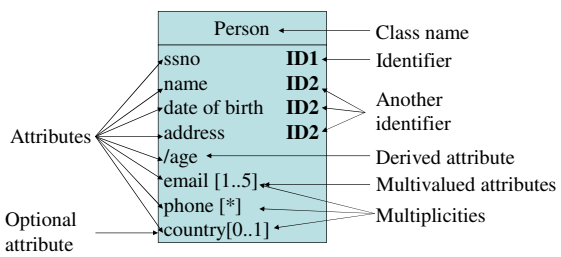
In the other words, a set of all humans includes a set of all students and it also includes a set of all lecturers

Examples

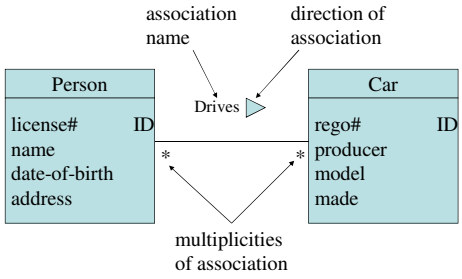
A class BAT is a generalization of classes GREYBAT, VAMPIRE-BAT, and BATMAN
It is so because a set of all grey bats is a subset of a set of all bats and …
… a set of all vampire bats is a subset of a set of all bats and …

In the other words, a set of all bats includes a set of all grey bats and it also includes a set of all vampire bats and it also includes a set of all batmen
… a set of all batmen is a subset of a set of all bats

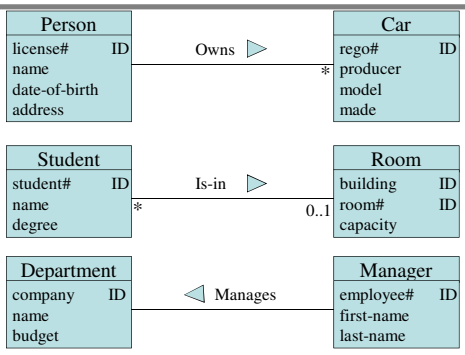
Class of objects



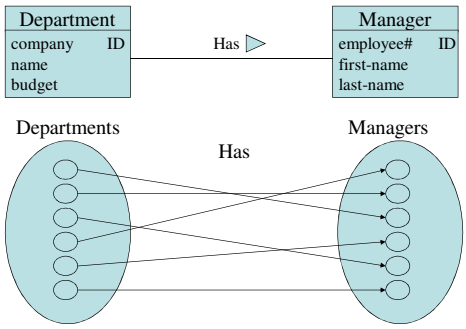
Association



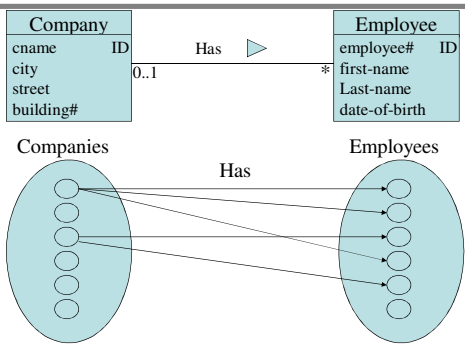
Examples



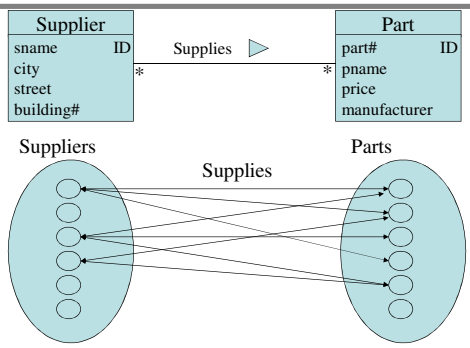
One-to-one association



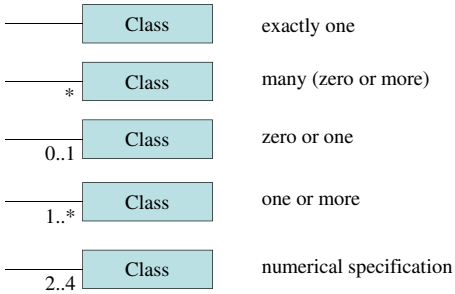
One-to-many association



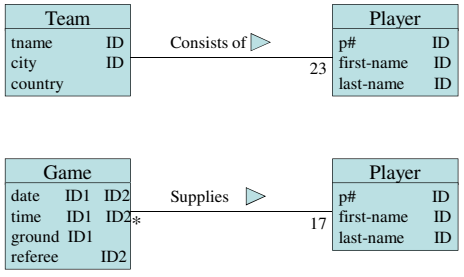
Many-to-many association



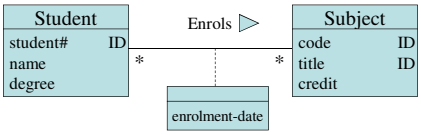
Multiplicities



Examples

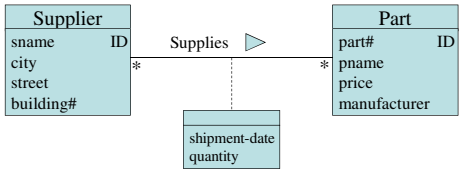


Link attribute



Link attribute is an attribute that describes an association

Link attribute



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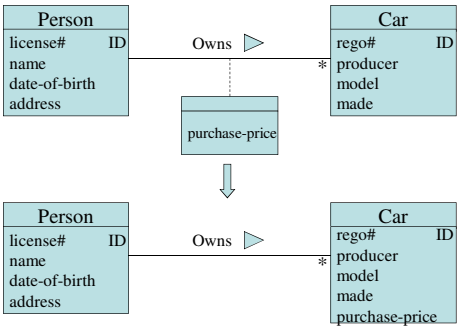
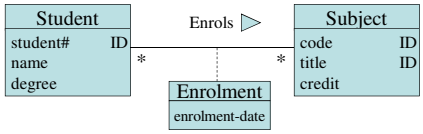
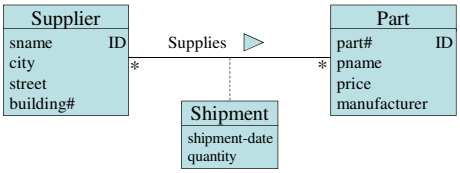


Association class



Association class is a class that encapsulates an association

Association class



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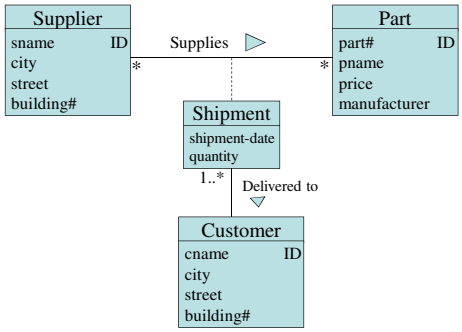
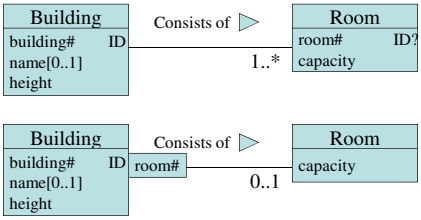
Association class

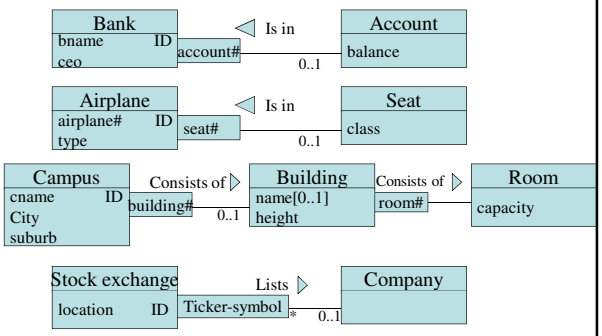


Qualified association

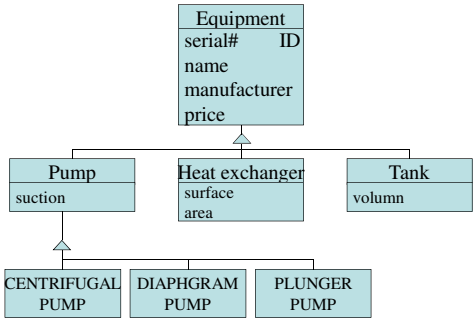


Qualified association is an association in which the objects on *many* side are partially or fully disambiguated by an attribute called as qualifier

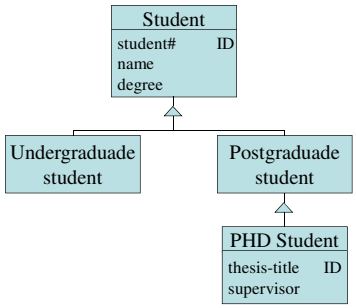
Examples



Generalization



Example



What about Entity-Relationship diagrams ?

Oh yes, we almost forgot about it, hmmmm, yes, it is the oldest conceptual modeling notation …

Entity, Entity type

Entity is an object in the real world that is distinguishable from other objects

Entity type is a collection of distinguishable real-world objects with common properties

Examples

Part, Supplier, Student, Person, Computer, Course, Shipment, Enrolment, Accident, …

Graphical representation

Attribute

Attribute is a property of entity or relationship

Examples
Part(pnumber, colour, price, manufacturer),
Student(snumber, name, degree, date-of-birth)
Accident(date, location, status)

Graphical representation

Relationship, Relationship set

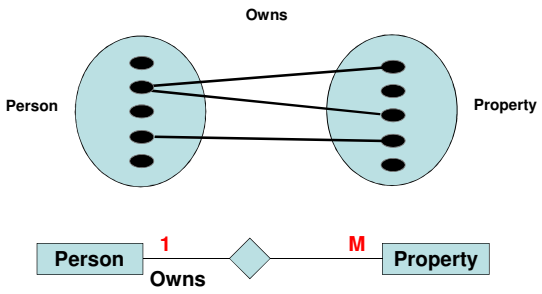
Relationship is an association among two or more entities

Relationship set is a collection of similar relationships

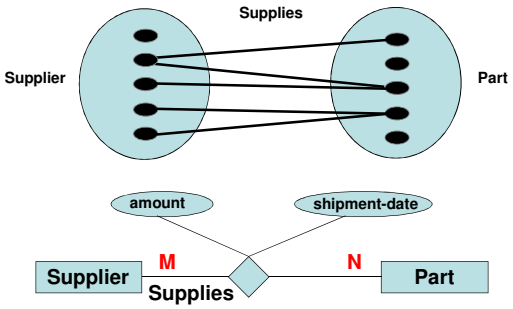
Examples
Supplier Supplies Part, Student Enrols Subject,
Driver Is-involved-in Accident, …

Graphical representation

Key constraint = (1:M)(M:1) relationship



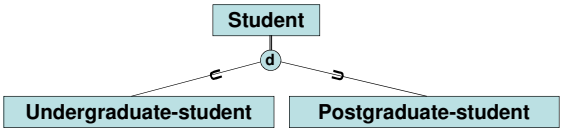
"Many-to-many" (M:N) relationship



Class hierarchy

Class hierarchy represent a subset relationship between the entity types

Example
Undergraduate-student ISA Student
Postgraduate-student ISA Student
Lecturer ISA Human

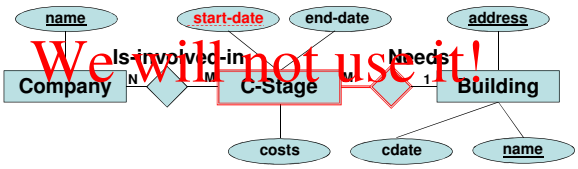


What about Entity-Relationship diagrams ?

Simply, in a class diagram replace:
classes of objects with entity types
attributes with attributes
identifiers with key constraints
associations with relationships
association classes with ???
link attributes with relationship attributes
qualification of associations with weak entity types
generalizations with generalizations
… and you will get an Entity-Relationship diagram

OMT ←→ ER

What about Entity-Relationship diagrams ?



We will not use it!

References

Elmasri R., Navathe S. B., *Database Systems*, chapters 9, 10