Data Management and Analysis
Unit 2
THE ENTITY-RELATIONSHIP MODEL

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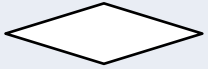
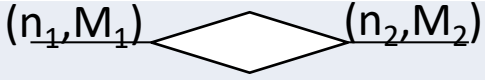
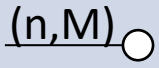
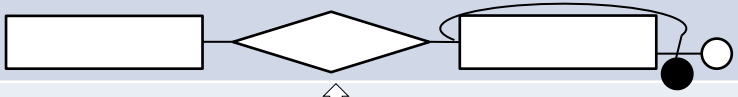
THE ENTITY-RELATIONSHIP MODEL

Definition

The **Entity-Relationship (ER) model** is a conceptual data model, and as such provides a series of constructs capable of describing the data requirements of an application in a way that is easy to understand and is independent of the criteria for the management and organization of data on the system

THE ENTITY-RELATIONSHIP MODEL

Construct

CONSTRUCT	GRAPHICAL RAPRESENTATION
Entity	
Relationships	
Attribute	
Cardinality of an (relathionship)	
Cardinality of an attribute	
Internal identifier	
External identifier	
Generalization	
Subset	

THE ENTITY-RELATIONSHIP MODEL

Construct: Entity

Entity represent classes of objects worthy of autonomous existence for context purposes

An **instance** (or occurrence) of an entity is an object of the class that the entity represents

THE ENTITY-RELATIONSHIP MODEL

Construct: Attributes

Attributes describe properties of interest to the entities

Attributes associate each entity instance with a value of a certain type (***attribute domain***)

Name is of type string character
Age is of type integer
Height is of type real

Instance example:

Name: Brad	Age:50	Heigth:1.85
Name: Angelina	Age:47	Heigth:1.65
Name: George	Age:52	Heigth:1.86

Possible duplicate:

Name: Brad	Age:50	Heigth:1.85

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Construct: Attributes (basic domain)

For modeling we can assume the existence of the following **basic domains**

BASIC	EXAMPLE
String/ charachter varying	“Hello” “Brad” “George”
Real	1.23 4.56 -7.89
Integer	23 12 74
Hour	11:45
Date	2023-05-12
Enum (a set of possibile choices)	{a,b,c,d} {yellow, red, white, black, green}
Record (grouping of base domains)	«“Brad”,74,11:56»

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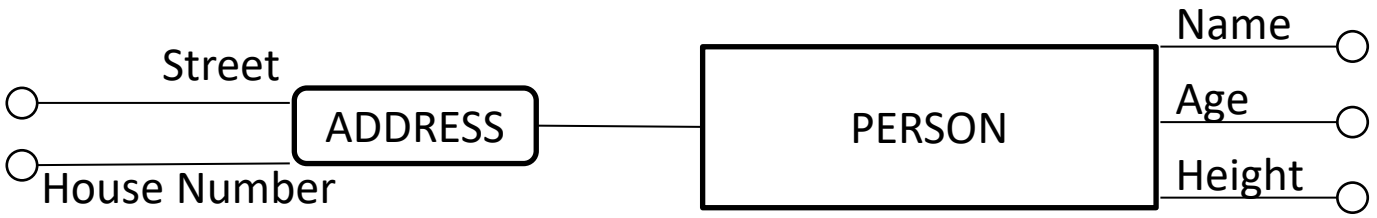
Construct: Attributes

Compound attributes are used to model more complex aspect



Name: String
Age: Integer
Height: Real
Adress: Record(Street:String, HouseNumber:integer)

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Construct: Association

Association (or **relationship**) represent logical links, of interest for the context to be modeled, between two or more entities

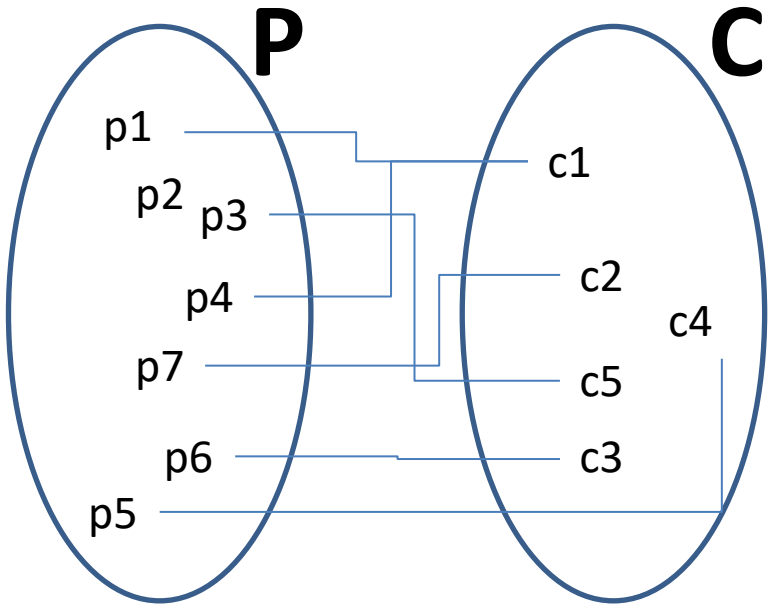
An **occurrence of a relationship** is an n-tuple consisting of instances of the entities involved

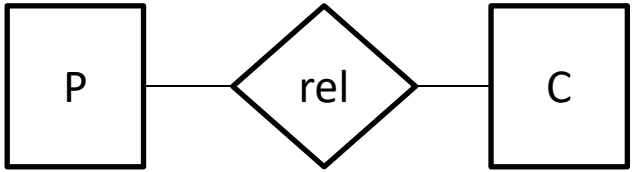
Residence: (Brad, NewYork)
Residence: (Angelina, Los Angeles)

THE ENTITY-RELATIONSHIP MODEL

Construct: Association

Association is a subset of the Cartesian product between the instances of the entities involved





rel $\subseteq$ PxC

rel1(p1,c1):p1$\in$P, c1 $\in$C

rel2(p3,c5):p3$\in$P, c5 $\in$C

…

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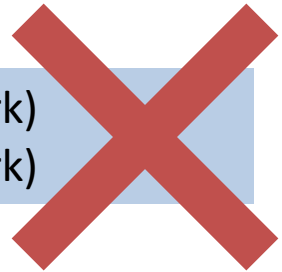
Construct: Association (remark)

Since a relationship ***rel*** is a set of pairs there can be **no duplicates**

There cannot be two instances of ***rel*** that bind the same pair of entities

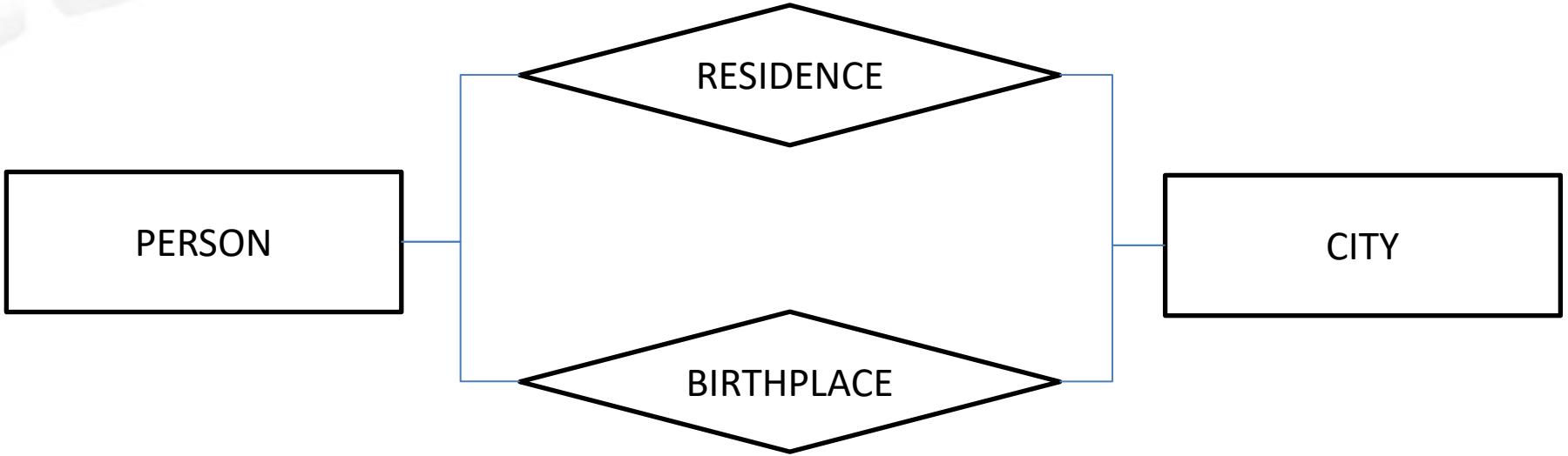
Residence: (Brad, NewYork)
Residence: (Brad, NewYork)



THE ENTITY-RELATIONSHIP MODEL

Construct: Association *recursivity*

The entity **assumes different relationships**

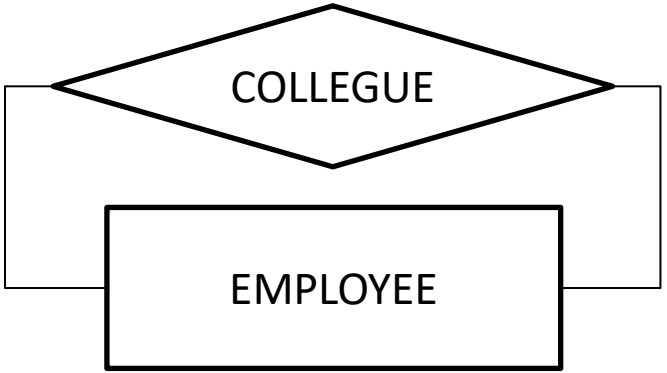


Residence: (George, NewYork)
BirthPlace: (George, Lexington)

THE ENTITY-RELATIONSHIP MODEL

Construct: Association *recursivity*

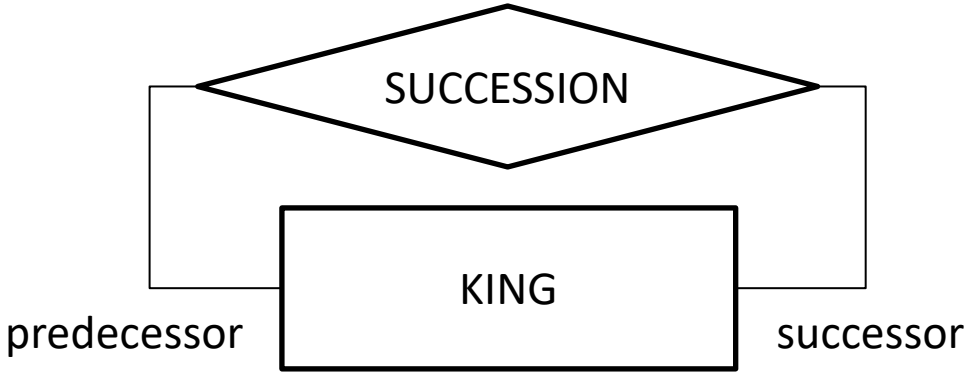
Recursive relationships is, relationships between an entity and itself



THE ENTITY-RELATIONSHIP MODEL

Construct: Association *recursivity*

The entity **assumes different roles** (it is not symmetric)



Schema instance:
Instances (KING)={George V, Edward VIII, George VI, Elisabeth II, Carlo III}
SUCCESSION:(Predecessor:George V, Successor:GeorgeVI),
SUCCESSION:(Predecessor:Edward VIII, Successor:Elisabeth II)
SUCCESISON:(Predecessor:George VI, Successor:Carlo III) }

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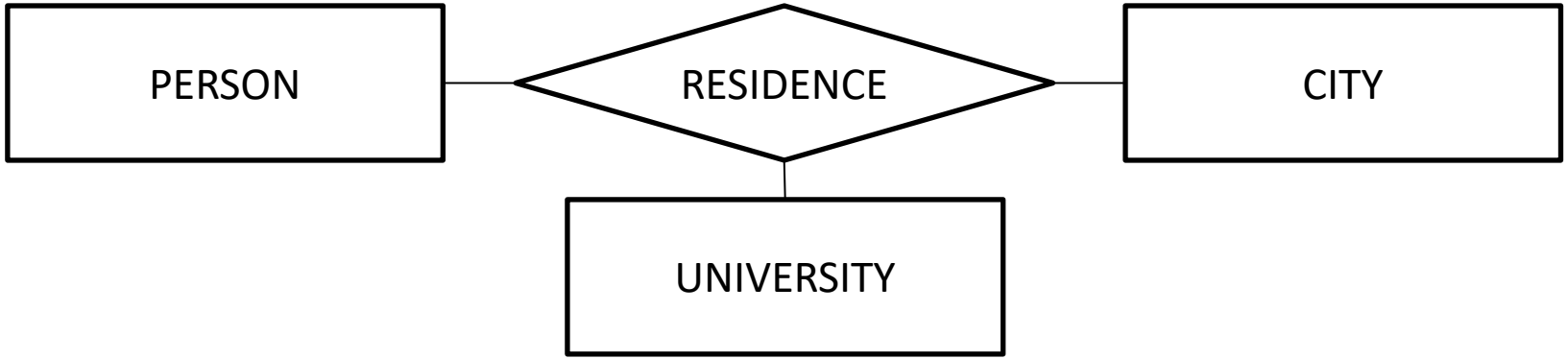
Construct: Association *n-ary*

Relationships **can involve more than two entities**



Examples of instances of the supply relationship are:

George, Columbia University, New York
Brad, Fordham University , New York
Angelina, Standford, California

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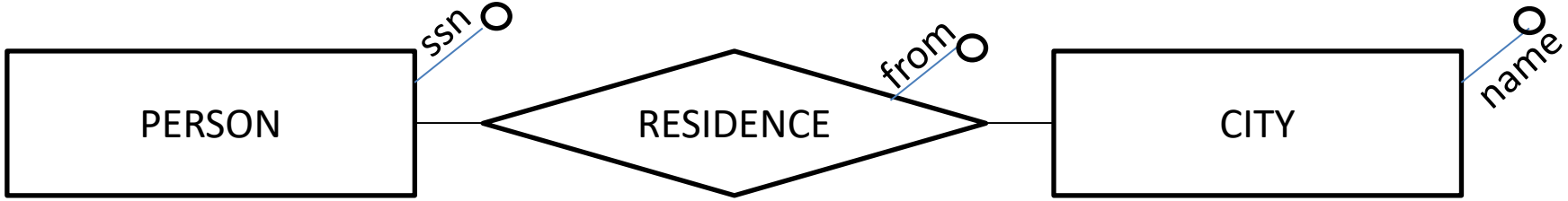
Construct: Association *attributes*

Attributes are property of a relationship

An attribute assigns each n-tuple a value belonging to a certain domain



An instance of the residence relationship is assigned a value for the relationship attribute by the

PERSON		RESIDENCE		CITY	
Attribute	Domain	Attribute	Domain	Attribute	Domain
SSN	String	From	Date	Name	String

Other constructs

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Cardinality of association

The **cardinality of relationship** describe the minimum and maximum number of occurrences of a relationship in which an entity occurrence can participate

Example:

- A person can reside at least in 1 and at most in 1 city
- A city can have a minimum of 0 and a maximum of 50000 residents

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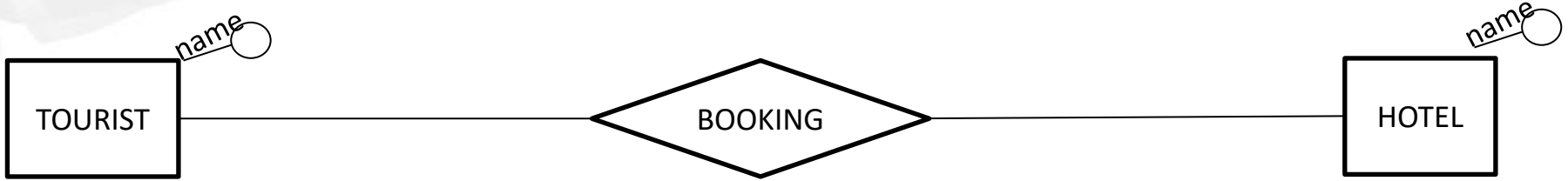
Cardinality of associations (remark)

Beware of inconsistencies



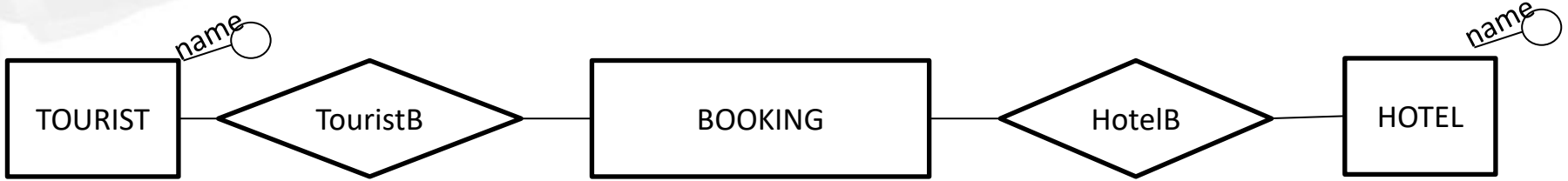
Booking (Brad, La Sorisa)
Booking (George,GrandHotel)
Booking (George,HiltonHotel)
Booking (Angelina,FashionHotel)
Booking (Brad, La Sorisa)

A tourist cannot book the same hotel several times! (Brad is not very smart!)

THE ENTITY-RELATIONSHIP MODEL

Cardinality of associations (remark)

Beware of inconsistencies



Angelina	(Angelina,Booking1)	Booking1	(LaSonrisa,Booking1)	LaSonrisa
Brad	(Brad, Booking2)	Booking2	(GrandHotel, Booking2)	Grand Hotel
	(Angelina, Booking3)	Booking3	(GrandHotel, Booking3)	
	(Brad, Booking4)	Booking4	(GrandHotel, Booking4)	

A tourist cannot book the same hotel several times! (Brad is not very smart!)

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Cardinality of associations (remark)

Inconsistencies (solution)

Each instance of BOOKING must include:

- Exactly one instance of TouristB (it is related to a Tourist)
- Exactly one instance of HotelB (it is related to a Hotel)

Each instance of TOURIST can be involved in an arbitrary number of reservation/booking (TouristB relationship)

Each instance of HOTEL can be involved in an arbitrary number of reservations/booking

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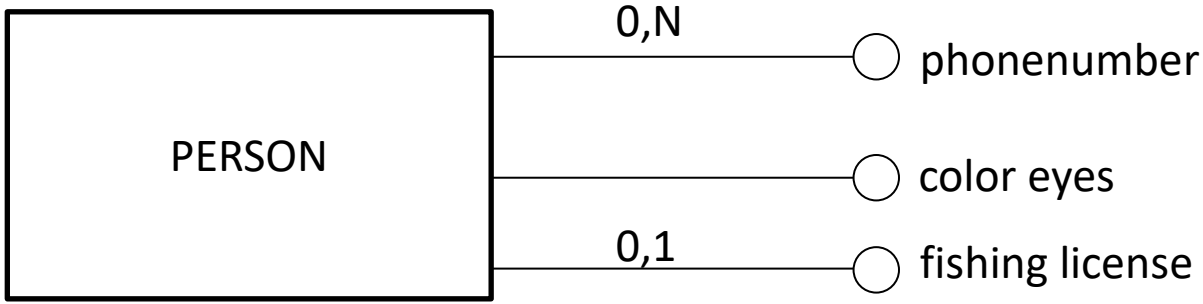
Cardinality of attributes

Cardinality of attributes describes the minimum and maximum number of attribute values associated with each entity or relationship occurrence

If the cardinality is (1,1) it is omitted (it is the default option)

If *null* we use minimum cardinality 0



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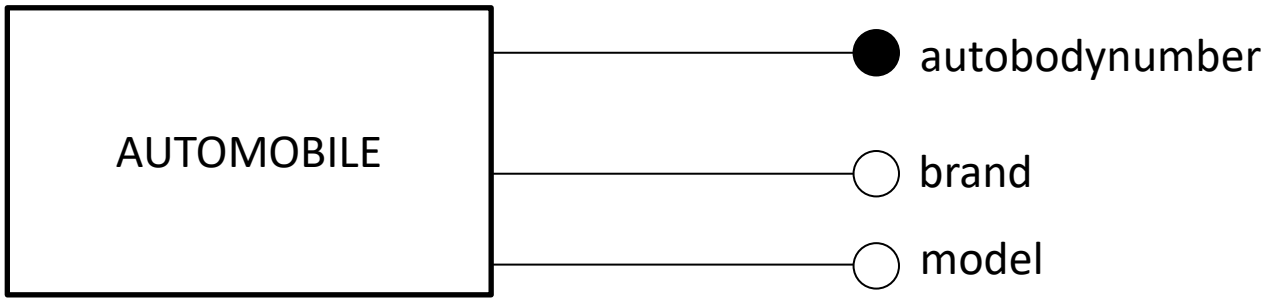
Identifier

Identifier (for an entity E) is a set of attributes (I) and/or relationship roles in which E is involved, such that:

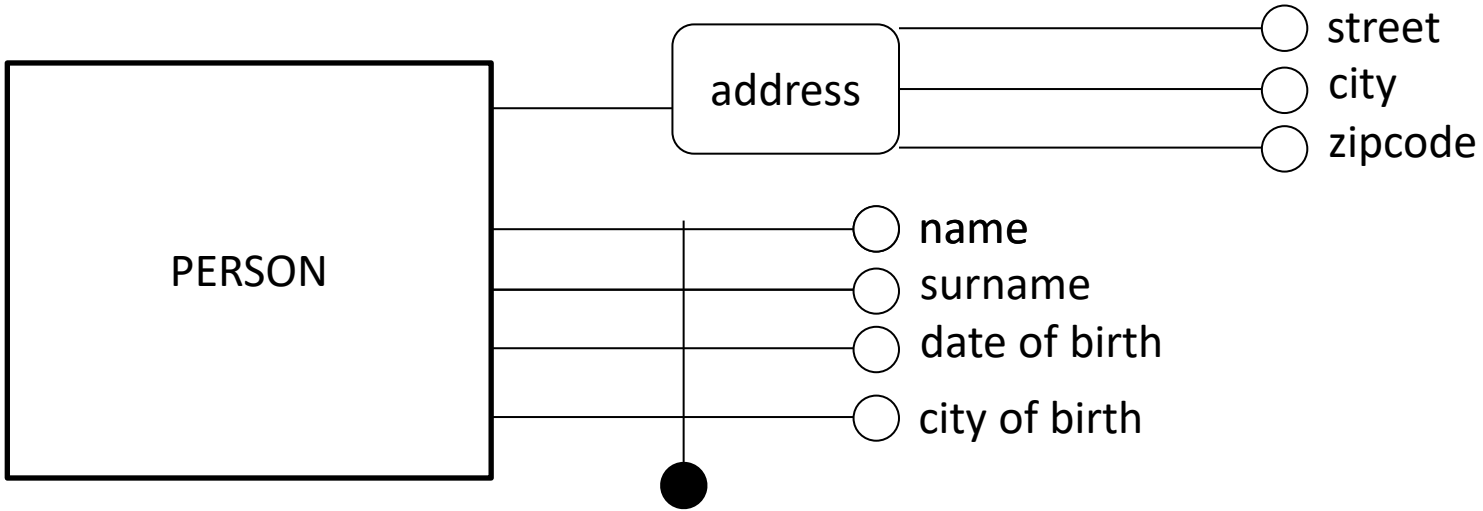
- There are no two instances of E that coincide in all values of I



THE ENTITY-RELATIONSHIP MODEL

Internal identifier - KEY

One or more attributes of the entity are sufficient to uniquely identify its occurrences



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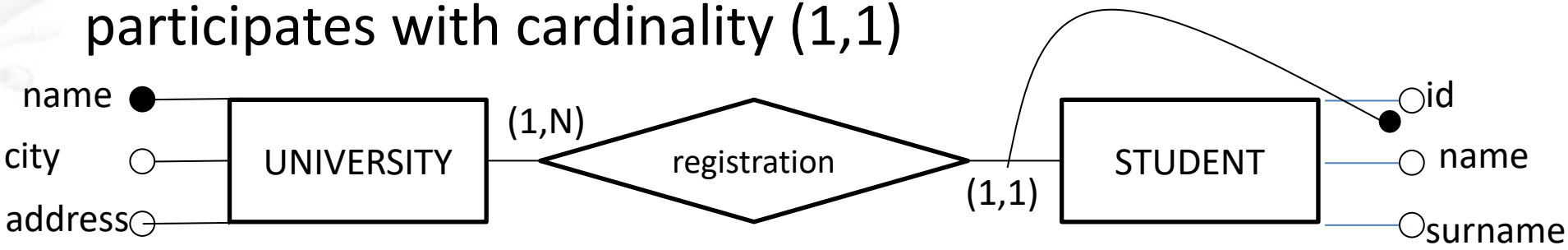
Foreign identifier – FOREING KEY

An entity can be identified by other entities only if those entities are involved in a relationship in which entity participates with cardinality (1,1)



ID alone is not an identifier for a student; we also need to know the university where the student is enrolled

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Entity identifier: constraint on relationship

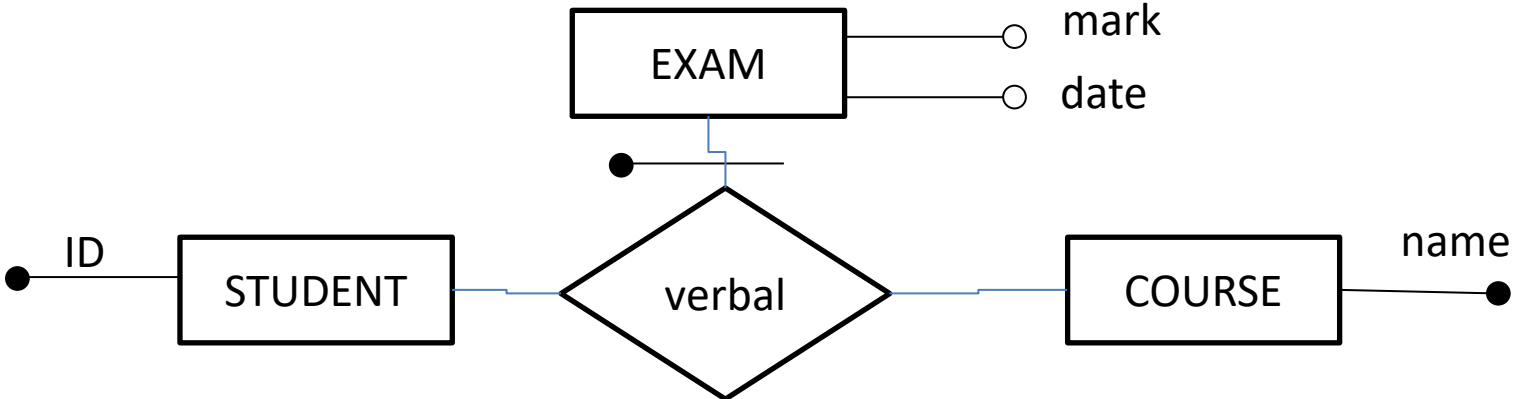
An **identification constraint** can involve even a single relationship role

Assume to represent information about students, exams and courses

There are no two students with the same ID

There are no two courses with the same name

There are no two exams for the couple (student, course)

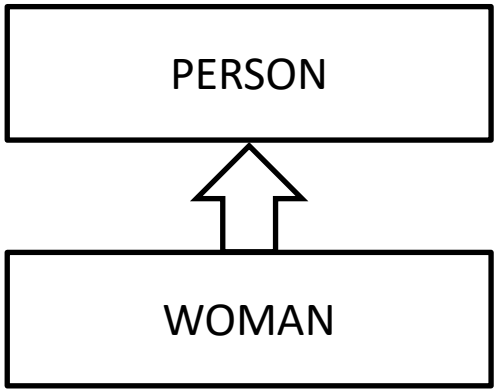


THE ENTITY-RELATIONSHIP MODEL

Generalizations

Generalizations represent logical links between an entity E, known as **parent entity**, and one or more entities E1 ,…, En, called **child entities**, of which E is more general, in the sense that it comprises them as a particular case.

In this situation E is a **generalization** of E1 ,…, En and that the entities E1 ,…, En are **specializations** of the E entity



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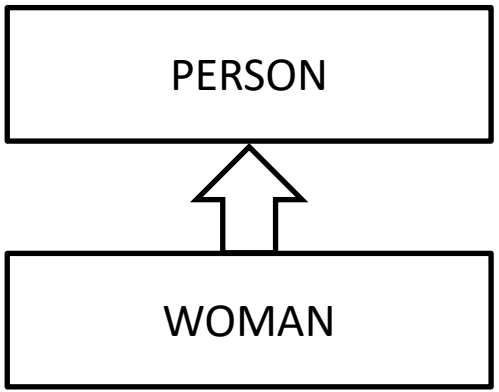
Generalizations

Each instance of Woman is (is-a) also an instance of Person

Person is called **basic entity** (more general)

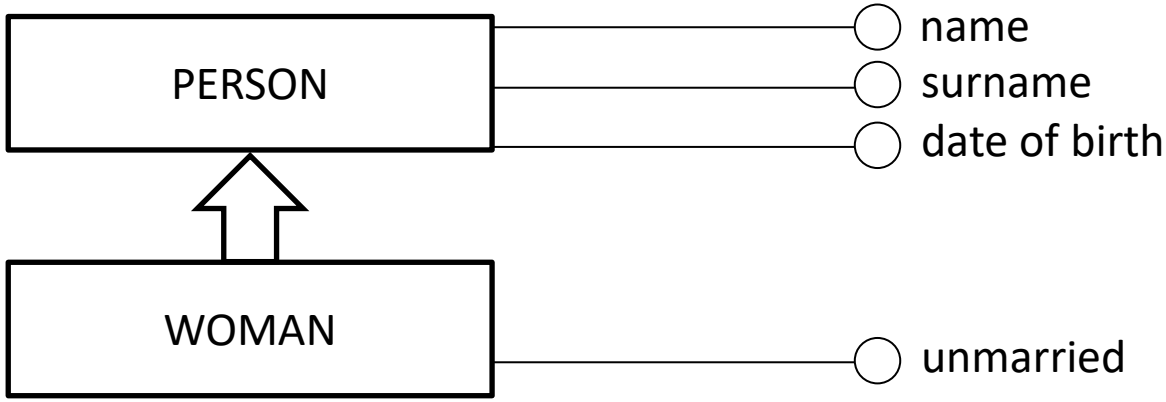
Woman is called **derived entity** (more specific)



THE ENTITY-RELATIONSHIP MODEL

Generalizations

The child entity inherits all attributes from the base entity



The attributes of the more general entity are inherited from the more specific entities (they should not be explicitly represented)

- The Woman entity inherits the First, Last Name and dataof birth attributes
- May have specific attributes such as Unmarried

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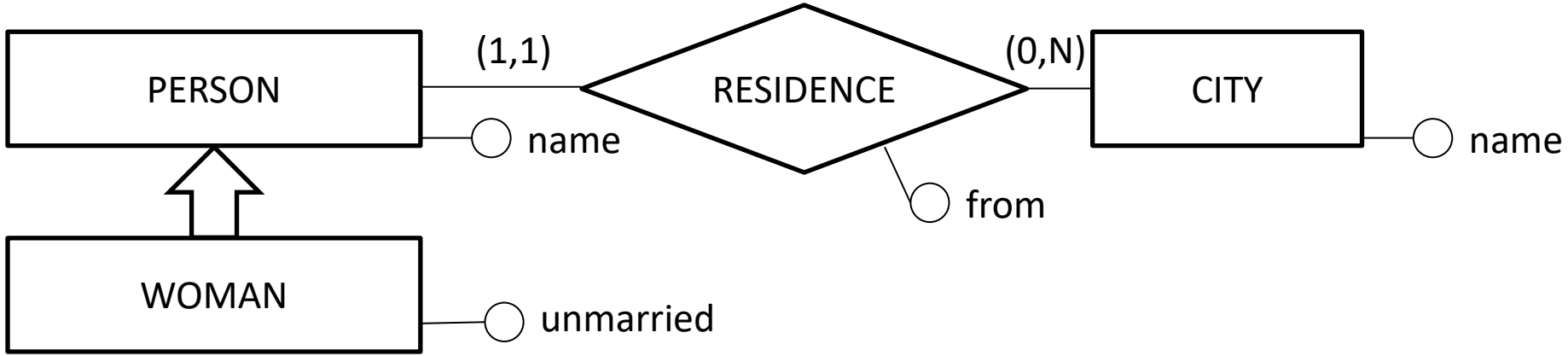
Generalizations: base entity in relationship

Each instance of base entity must be involved in only one instance of the relationship

Each instance of derived entity is also an instance of basic entity

Derived entity may be involved in other relationships



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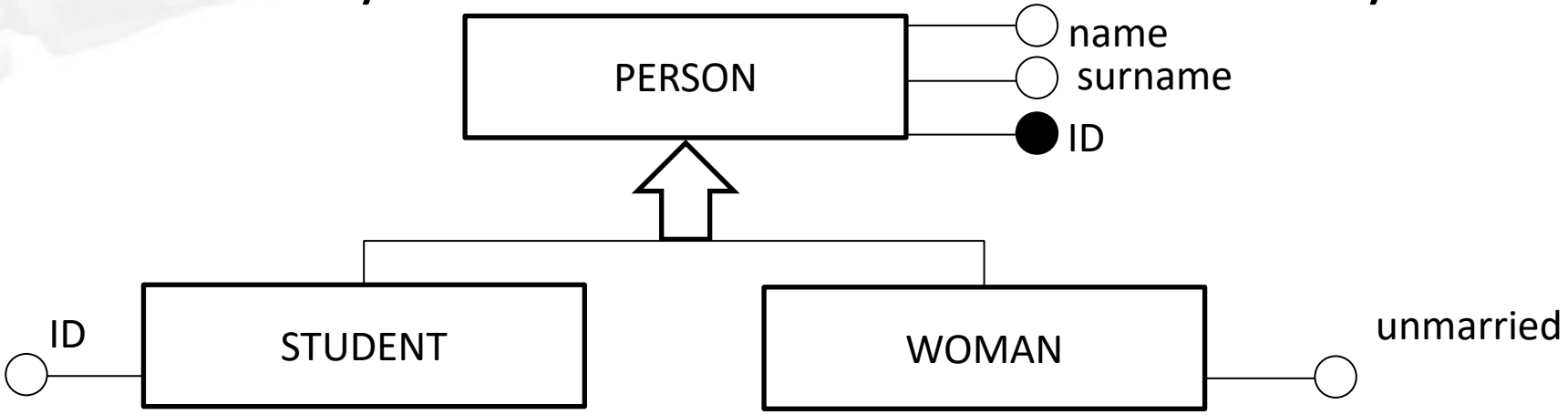
Generalizations: father and children

A basic entity can have more than one child entity



- Each Instance of Student is also an Instance of Person
- All instances of Woman are instances of Person
- There may be instances of a Person who are neither a woman nor a Student
- There may be instances of Person who are both Woman and Student

THE ENTITY-RELATIONSHIP MODEL

Generalizations: classification

A generalization is **total** if each occurrence of the parent entity is an occurrence of at least one of the child entities, otherwise it is **partial**

A generalization is **exclusive** if each occurrence of the parent entity is at most one occurrence of one of the child entities, otherwise it is **superimposed** (or overlapping)

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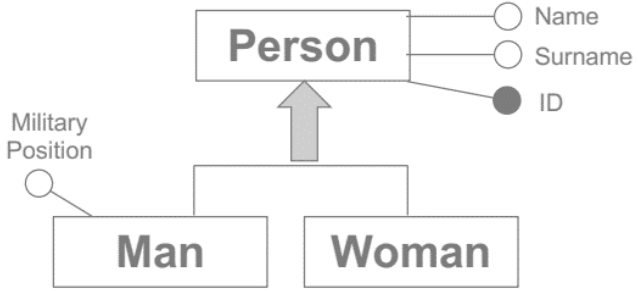
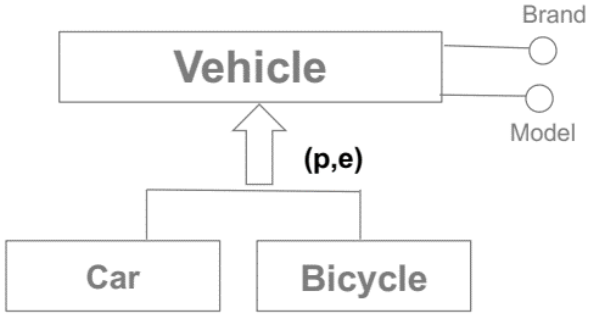
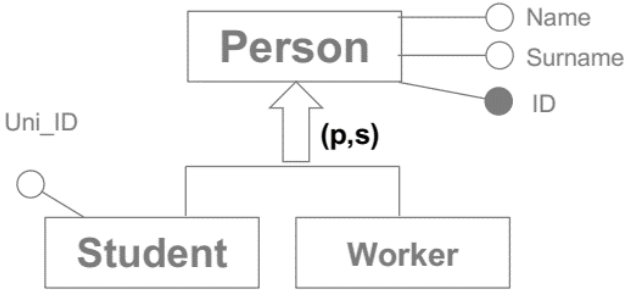
Generalizations: classification



Total and exclusive generalization



Partial and exclusive generalization



Partial and overlapping generalization

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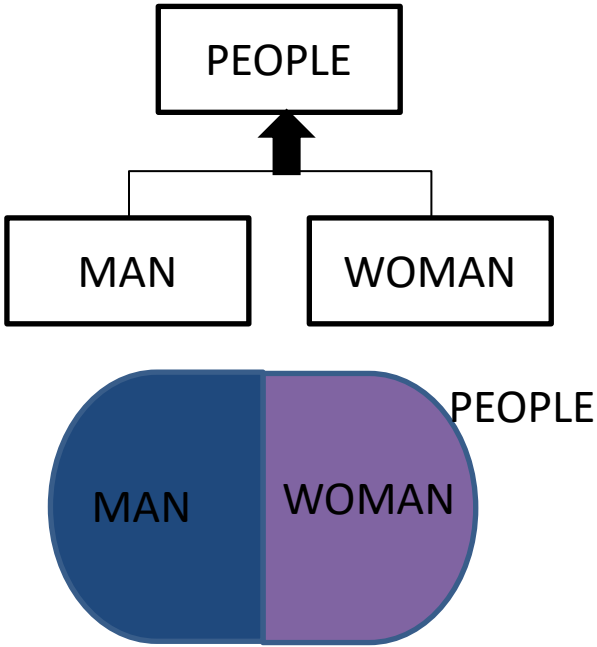
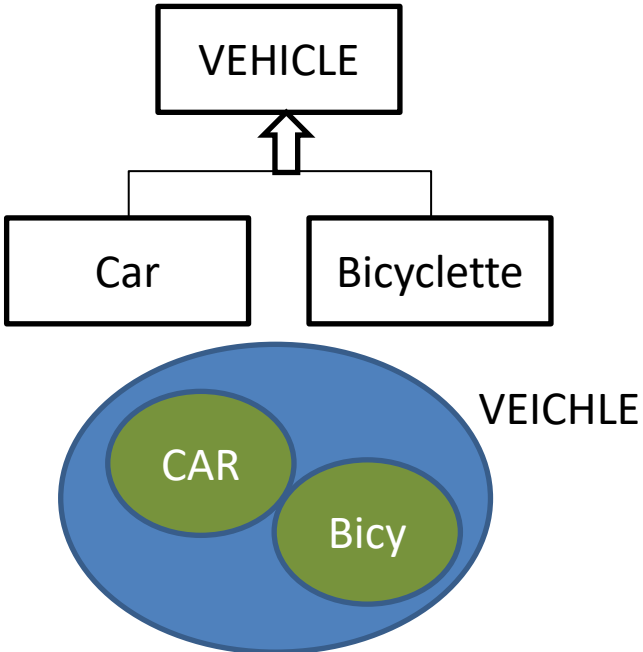
Generalizations: classification (remark)

COMPLETE GENERALIZATIONS



INCOMPLETE GENERALIZATIONS



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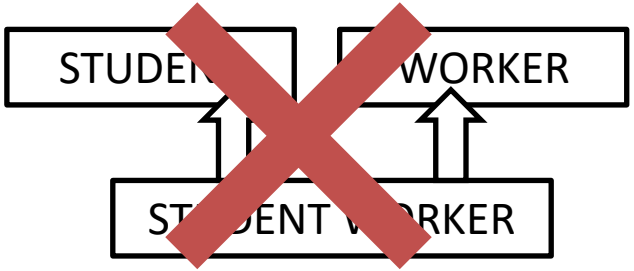
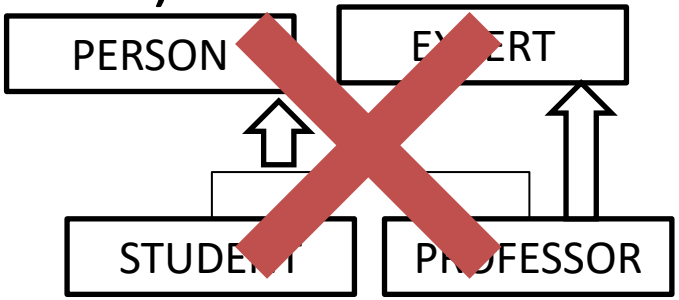
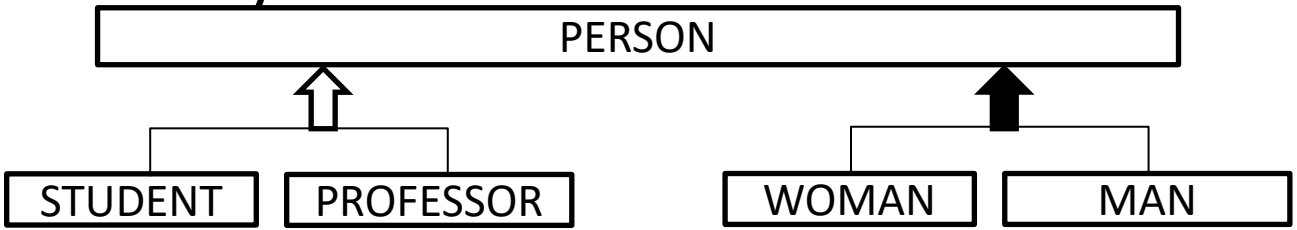
Generalizations: inheritance

An entity cannot have more than one basic entity (The ER language only allows single inheritance)





however it is possible multiple generalizations with the same base entity




End