LoD – The practice
(T2MP)

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- **Language of etype percepts**
- Language of composite etype percepts
- Language of descriptions
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- TBox cyclic / acyclic, Terminology
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- Key exercizes

Alphabet

Definition (Alphabet A**)***

$$A_T = < \{T\}, \{P\} >$$

where:

- $\{T\} = \{E_i\} \cup \{D_i\}$ is a set of unary predicates standing for **etypes** and **dtypes**;
- $\{P\} = \{O_i\} \cup \{A_i\}$ is a set of binary **properties**, where O_i is an **object property**, also called a **role**, and A_i is an **attribute**.

Observation (Alphabet of percepts). Similarly to LoE, A_T is an aphabet which denotes percepts in the domain (but denoting a different set of percepts).

*The elements of the alphabet are written in *italic* to distinsguish them from percepts

Formation rules – BNF

< p_T > ::= <etype> | <dtype> |⊤|⊥

< etype > ::= ∃<objProp> .<etype> |
∃<dataProp>.<dtype> |
∀<objProp> .<etype> |
∀<dataProp> .<dtype>

<etype> ::= E_1 | …| E_n

<dtype> ::= D_1 | …| D_n

<objProp> ::= O_1 | …| O_n

<dataProp> ::= A_1 | …| A_n

Observation (BNF). This BNF does allow the iterative application of the formation rules on etypes (dtypes cannot be changed). It allows for the generation of etype percepts of any depth.

Observation (BNF). Entities are not mentioned (not part of the language). They are referred implicitly via the existential quantifier and also, somehow via the universal quantifier.

Interpretation of etype percepts

$I_T(\top) = U$, with U the universe of interpretation

$I_T(\bot) = \emptyset$, with $\emptyset$ the empty set

$I_T(E_i) = E_i$

$I_T(D_i) = D_i$

$I_T(\exists P.T) = \{d \in U \mid$ there is an $e \in U$ with $(d, e) \in I_T(P)$ and $e \in I_T(T)\}$

$I_T(\forall P.T) = \{d \in U \mid$ for all $e \in U$ if $(d, e) \in I(P)$ then $e \in I_T(T)\}$

where I_T is the interpretation function of L_T

Observation (Interpretation function). For an intensional view of the interpretation functions for etypes, dtypes, object properties and attributes, follow what done with LoE.

Observation (Interpretation of nested etypes). It is sufficient to interpret the application of the second external quantifier to the etype built via the application of the first quantifier.

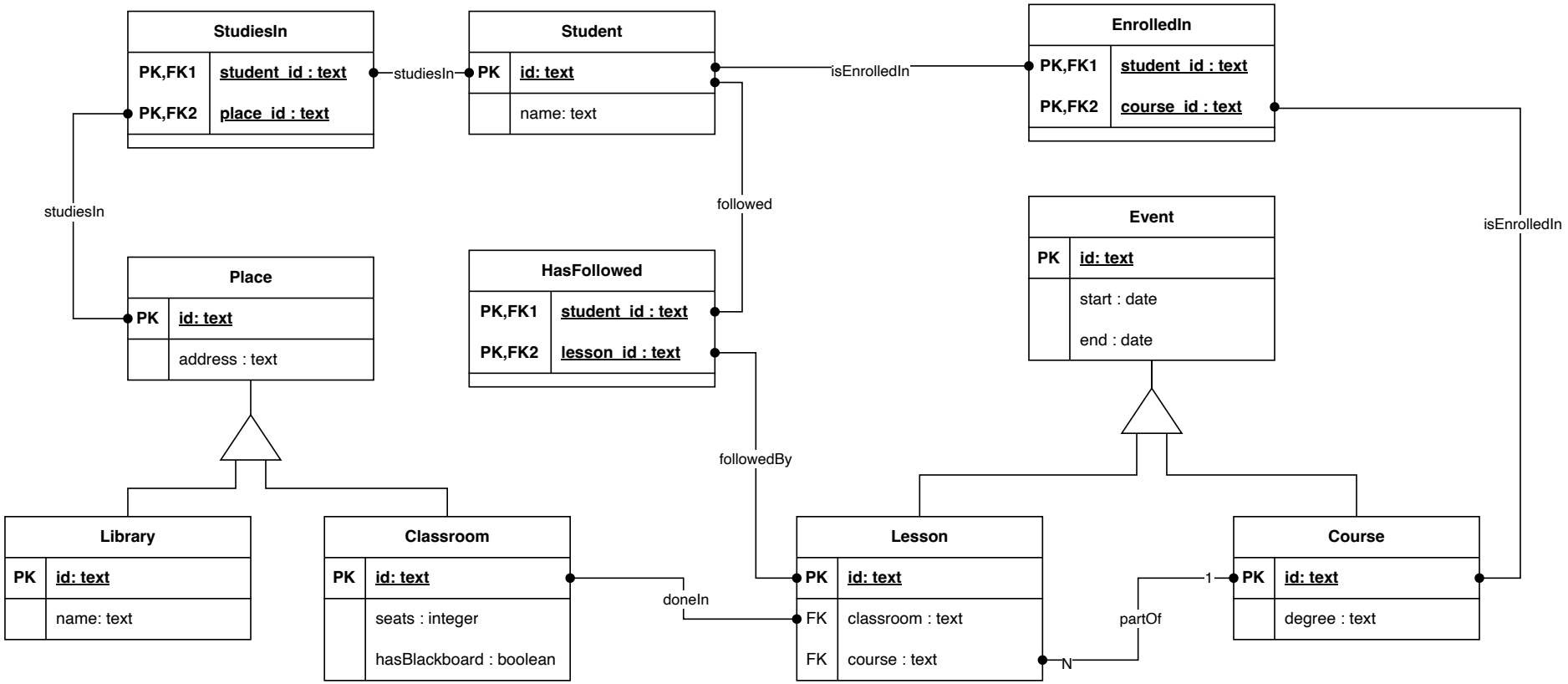
Exercize 1 - Informal to formal (Language of etype percepts)

Formalize the following definitions in natural language using the Language of etype percepts.

- The set of entities that study in the Library. $\exists studiesIn.Library$
- The set of entities that reads Books. $\exists reads.Book$
- The set of entities that reads only Comic Books. $\forall reads.ComicBook$
- The set of entities that are friends with only entities that study in the Library. $\forall friendsWith.(\exists studiesIn.Library)$

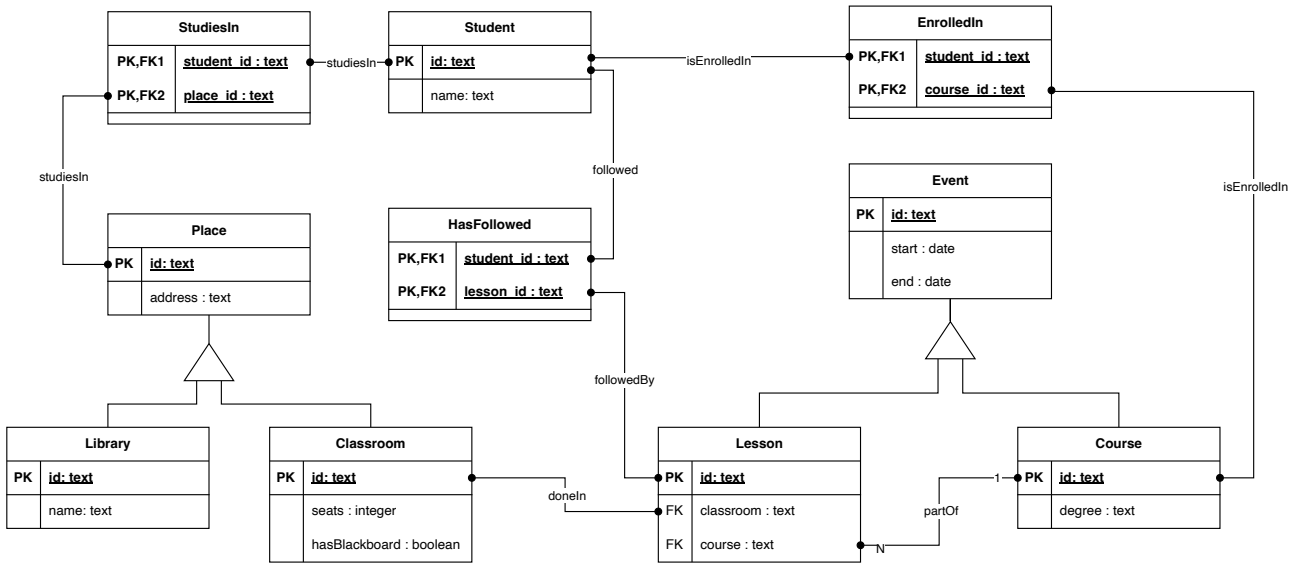
Exercize 2 : Semiformal to Formal (Language of etype percepts)

Formalize using the Language of etype percepts the fact represented in the following EER diagram.



Exercize 2 : Semiformal to Formal (Language of etype percepts)

Formalize using the Language of etype percepts the fact represented in the following EER diagram.



$Student$
$Place$
$Library$
$Classroom$
…

$\exists hasName.Text$
$\forall hasName.Text$
$\exists hasStart.Date$
$\forall hasStart.Date$
…

$\exists studiesIn.Place$
$\forall studesIn.Place$
$\exists studiesIn.Library$
$\forall studiesIn.Library$
$\exists studiesIn.Classroom$
$\forall studiesIn.Classroom$
…

Exercize 3 : Semiformal to Formal (Language of etype percepts)

Formalize using the Language of etype percepts the fact represented in the following DB.

BookSeries	
name	writer
Foundation	p_1
Robot	p_1

Person	
person_id	name
p_1	Isaac Asimov
p_2	Will Smith

Movie		
name	adapted_from	produced_in
I Robod	Robor	2004

ActedIn	
movie_id	actor_id
I Robot	p_2

Exercize 3 : Semiformal to Formal (Language of etype percepts)

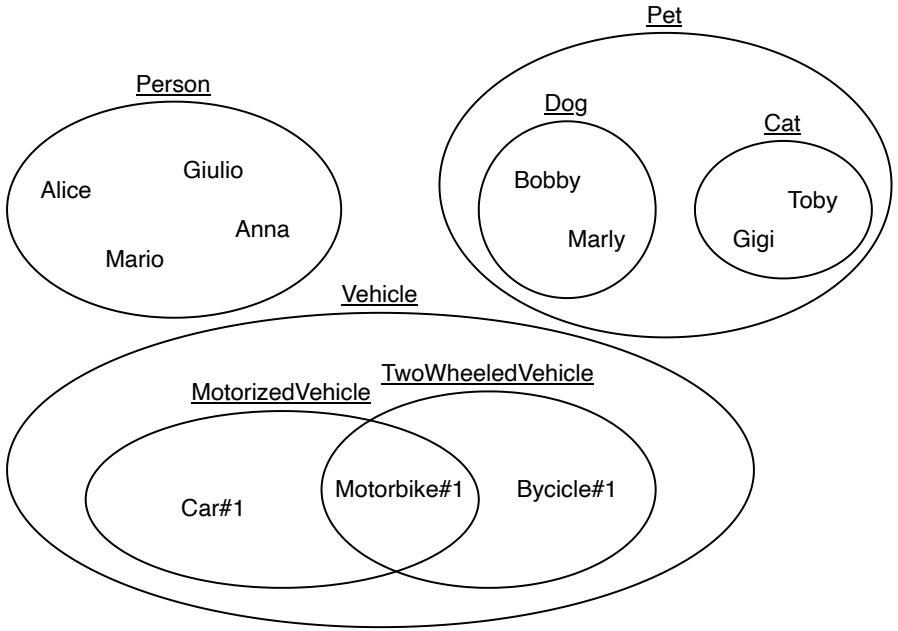
Formalize using the Language of etype percepts the fact represented in the following DB.

There is no translation!

An EG doesn't specify etypes and,
therefore, cannot be formalized in LoD,
NOT EVEN PARTIALLY,
as LoD does not allow for
"Data-level" assertions

Exercize 4: Intended model (Language of etype percepts)

Given the following intended model, determine the set of entities represented by the assertions in language of etype percepts.



$< Alice, Toby >\in ownerOf$
$< Giulio, Gigi >\in ownerOf$
$< Anna, Marly >\in ownerOf$
$< Mario, Motorbike\#1 >\in ownerOf$
$< Anna, Bycicle\#1 >\in ownerOf$

$MotorizedVehicle$	$\{Car\#1, Motorbike\#1\}$
Pet	$\{Bobby, Marly, Toby, Gigi\}$
$\exists ownerOf.Pet$	$\{Alice, Anna, Giulio\}$
$\forall ownerOf.Cat$	$\{Alice, Giulio, Car\#1, Motorbike\#1, Bycicle\#1, Toby, Bobby, Gigi, Marly\}$

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Formation rules – BNF

$$< p_C > \ ::= < p_C > \sqcap < a_C > \ |$$
$$< p_C > \sqcup < p_C > \ |$$
$$\neg < p_C >$$
$$< p_C > ::= < p_T >$$

Notation (BNF). $< p_C >$ is a nonterminal symbol and it stands for a p_C percept. $< p_T >$ is an L_C terminal symbol and it stands for an L_T percept. See the BNF of L_T to see how to expand it to a LoD terminal symbol.

Observation (BNF). This BNF does allow the iterative application of the formation rules. It allows to generate percepts of any depth.

Interpretation of composite etype percepts

$$I_C(p_1 \sqcap p_2) = I_C(p_1) \cap I_C(p_2)$$
$$I_C(p_1 \sqcup p_2) = I_C(p_1) \cup I_C(p_2)$$
$$I_C(\neg p_1) = \cup \setminus I_C(p_1)$$
$$I_C(p_T) = I_T(p_T)$$
$$I_T(p_T) = p_T$$

where:

- I_C is the interpretation function of L_C
- I_T is the intepretation function for L_T, the language of etype percepts.
- p_1, p_2 are composite etype percepts
- p_T (in *italic*) is (the name of an) etype percept denoting the domain percept p_T (not in italic)

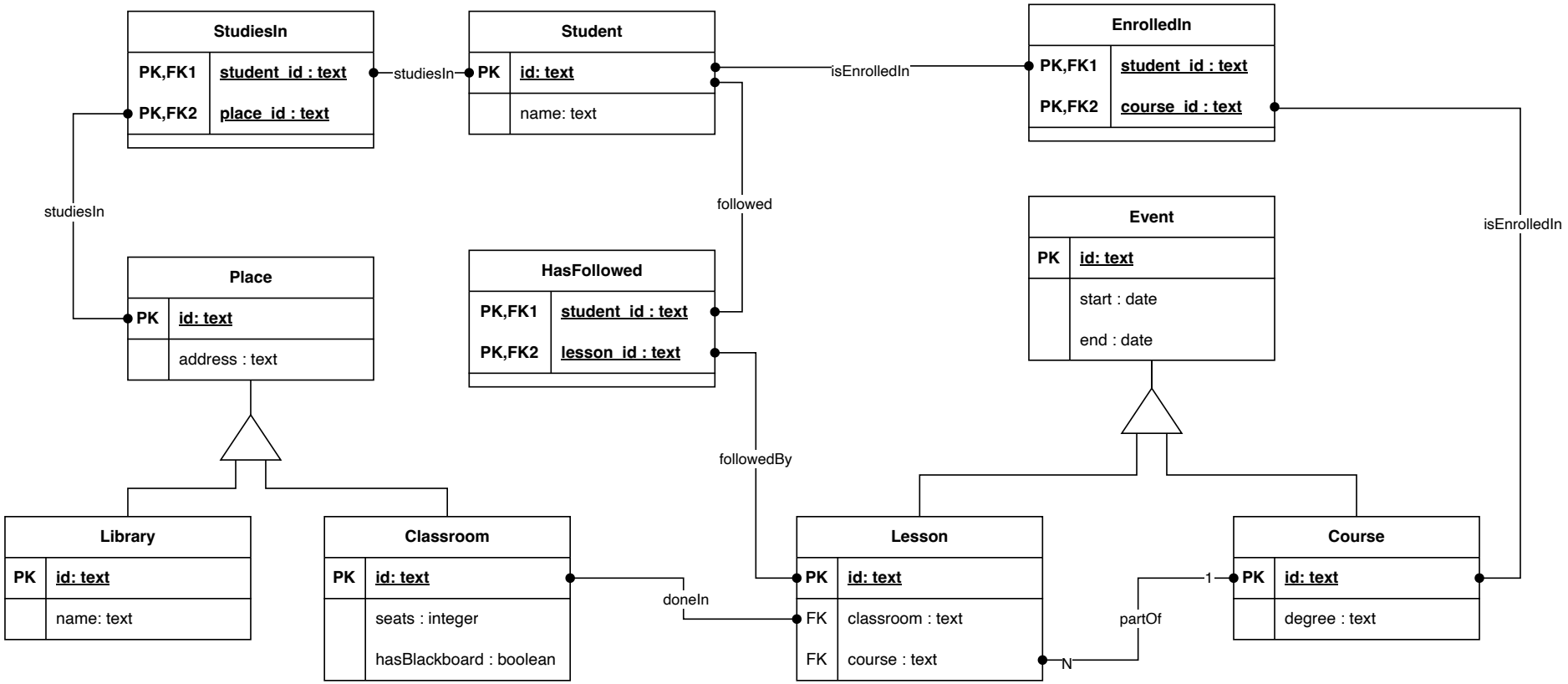
Exercize 5 - Informal to formal (Language of composite etype percepts)

Formalize the following definitions in natural language using the Language of composite etype percepts.

- The set of Employees that work at the Library. $Employee \sqcap \exists worksAt.Library$
- The set of Black tea and Green tea. $BlackTea \sqcup GreenTea$
- The set of Persons that do not drink Green tea. $Person \sqcap \neg\exists drinks.GreenTea$
- The set of entities that drink anything but Black tea. $\forall drink.\neg BlackTea$

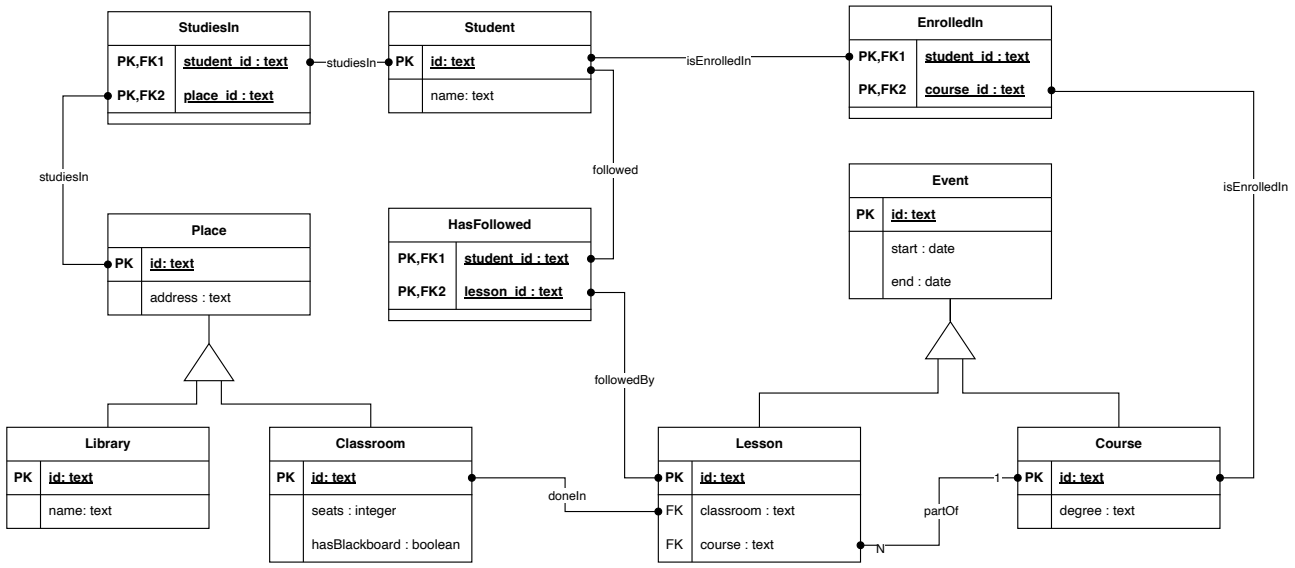
Exercize 6 - semiformal to formal (Language of composite etype percepts)

Formalize using the Language of composite etype percepts the fact represented in the following EER diagram.



Exercize 6 : Semiformal to Formal (Language of composite etype percepts)

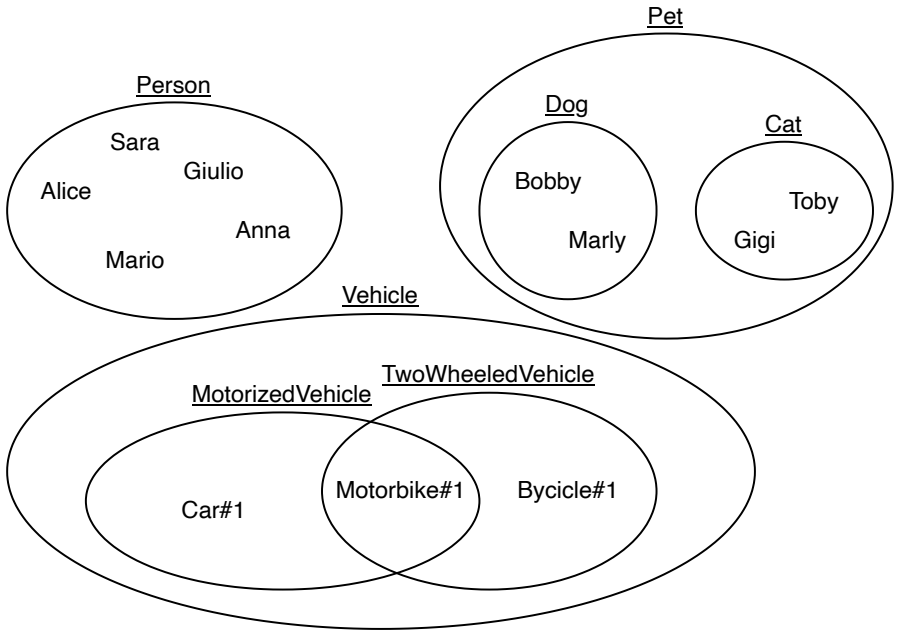
Formalize using the Language of etype percepts the fact represented in the following EER diagram.



$$Student \sqcap \exists studiesIn.Library$$
$$Student \sqcap \forall studiesIn.Library$$
$$Library \sqcup Classroom$$
$$Lesson \sqcap \exists partOf.Course$$
$$Lesson \sqcup \exists hasName.Text$$
$$Place \sqcap \exists hasName.Text$$
...

Exercize 7: Intended model (Language of composite etype percepts)

Given the following intended model, determine the set of entities represented by the assertions in language of composite etype percepts.



$< Alice, Toby > \in ownerOf$
$< Giulio, Gigi > \in ownerOf$
$< Anna, Marly > \in ownerOf$
$< Mario, Motorbike\#1 > \in ownerOf$
$< Anna, Bycicle\#1 > \in ownerOf$

$Person \sqcap \exists ownerOf.\neg Pet$ $\{Mario, Anna\}$

$\neg Vehicle \sqcap \neg Dog \sqcap \forall ownerOf.\bot$ $\{Toby, Gigi, Sara\}$

$\exists ownerOf.(Pet \sqcap \neg Cat)$ $\{Anna\}$

$Person \sqcap \neg \forall ownerOf.Cat$ $\{Anna, Mario\}$

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