



## RÈGLES EXISTENTIELLES: MOTIVATIONS

THÉORIE DES BASES DE CONNAISSANCES  
HMIN312M  
COURS DE ML MUGNIER

### EXISTENTIAL RULES

$$\forall x \forall y ( \text{Body } [x,y] \rightarrow \exists z \text{Head } [x,z] )$$

$x, y, z :$   
sets of variables

any **positive conjunction** (without functional symbols)

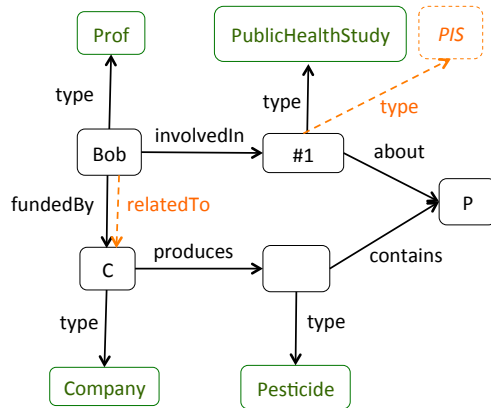
$$\forall x ( \text{actor}(x) \rightarrow \exists z \text{play}(x,z) )$$

$$\forall x \forall y ( \text{siblingOf}(x,y) \rightarrow \exists z ( \text{parentOf}(z,x) \wedge \text{parentOf}(z,y) ) )$$

Key point: ability to assert **the existence of unknown entities**

Crucial for representing ontological knowledge in **open domains**

## EXAMPLE: PART OF A "KNOWLEDGE GRAPH"



+ Basic ontological knowledge

PublicHealthStudy **subclass of** PublicInterestStudy  
fundedBy **subproperty of** relatedTo

### Facts

```

∃ b (
  Prof(Bob)      ^
  PHS(#1)       ^
  Comp(C)       ^
  Pest(b)       ^
  involvedIn(Bob,#1) ^
  fundedBy(Bob,C) ^
  about(#1,P)   ^
  produces(C,b) ^
  contains(b,P) ^
)

```

### Rules

```

∀ x (PHS(x) → PIS(x))
∀ x ∀ y (fundedBy(x,y) → relatedTo(x,y))

```

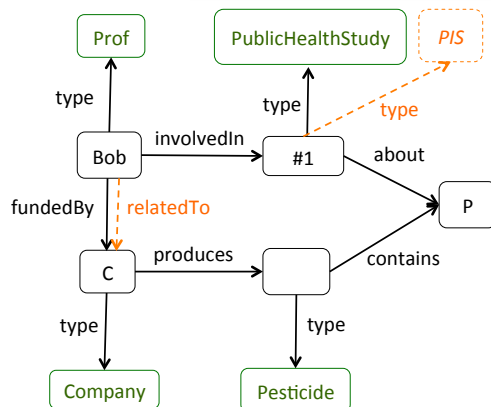
### Allow to infer:

PIS(#1), relatedTo(Bob,C)

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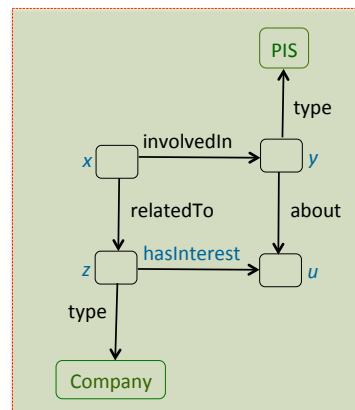
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## HOW TO INFER CONFLICTS OF INTEREST (COI) ?



**Query:** "Find all **x**, **y**, **z** such that **x** has a conflict for study **y** because of its relationships with company **z**"

What kind of **ontological knowledge** would allow to infer conflicts of interest?



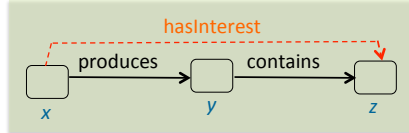
COI pattern

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## DEFINING CONFLICTS OF INTEREST

$$R_1: \forall x \forall y \forall z ( \text{produces}(x,y) \wedge \text{contains}(y,z) \rightarrow \text{hasInterest}(x,z) )$$

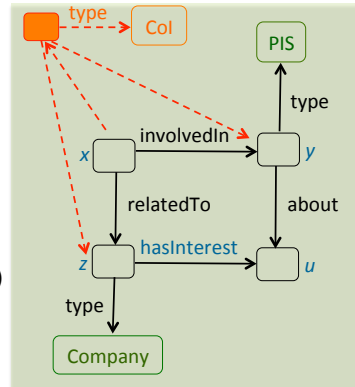


$$R_2: \forall x \forall y \forall z \forall u ( \text{involvedIn}(x,y) \wedge \text{PIS}(y) \wedge \text{about}(y,u) \wedge \text{relatedTo}(x,z) \wedge \text{Company}(z) \wedge \text{hasInterest}(z,u) \rightarrow \text{Col}(x,y,z) )$$

What if we only have unary and binary predicates  
ie graphs and not hypergraphs ?

**Reification:** new object of type Col

$$R_2: \forall x \forall y \forall z \forall u ( \text{body}[x,y,z,u] \rightarrow \exists o ( \text{Col}(o) \wedge \text{in}(x,o) \wedge \text{on}(o,y) \wedge \text{with}(o,z) ) )$$



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## CREATING NEW OBJECTS

$$R_2: \forall x \forall y \forall z \forall u ( \text{body}[x,y,z,u] \rightarrow \exists o ( \text{Col}(o) \wedge \text{in}(x,o) \wedge \text{on}(o,y) \wedge \text{with}(o,z) ) )$$

Interest of creating a new object:

- **Flexible** description of Col instead of a fixed arity predicate  
Not all Col need to be described by the same properties
- Ability to **talk about** Col because they become objects (reification)

$$\text{E.g. } R_3: \forall x \forall z ( \text{Col}(x) \wedge \text{with}(x,z) \wedge \text{ChemicalCompany}(z) \rightarrow \text{toBeInvestigated}(x) )$$

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## INFERRING CONFLICTS OF INTEREST

