The Ariac – Arbitrage Project

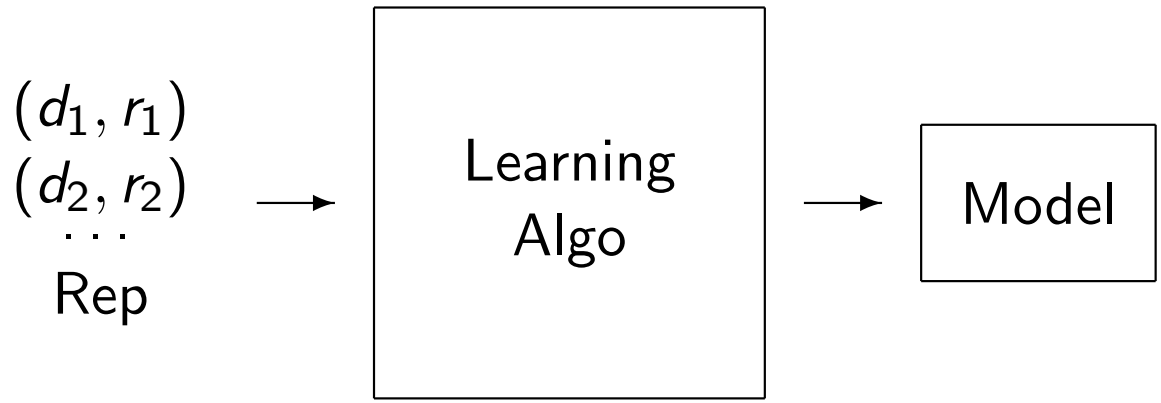
On Federated Learning

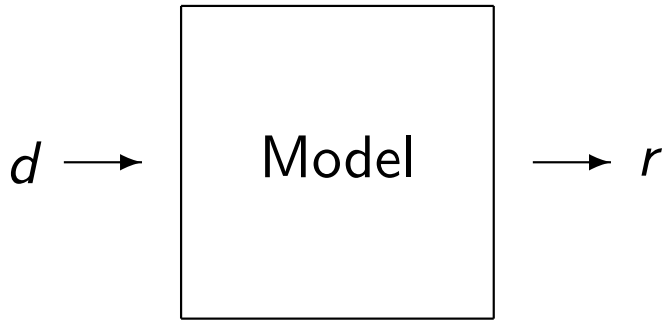
J.-M. Jacquet, I. Linden, W. Vanhoof

University of Namur

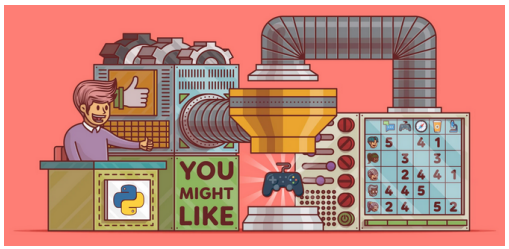
February 8th 2022

Machine learning in a picture

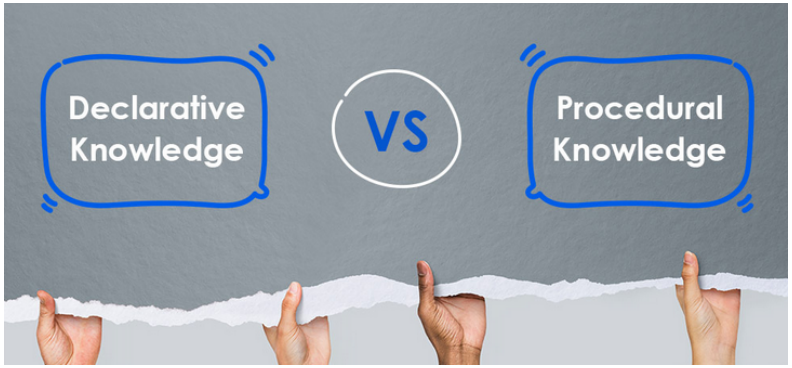


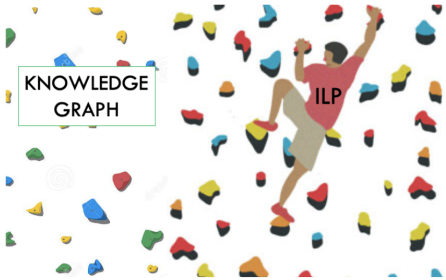


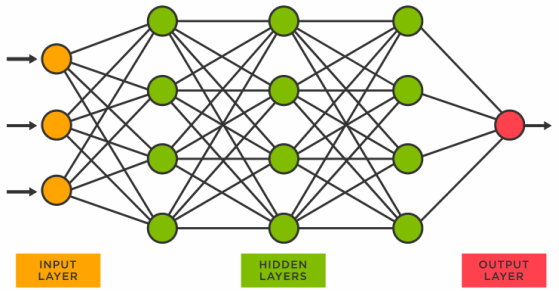
Typical applications

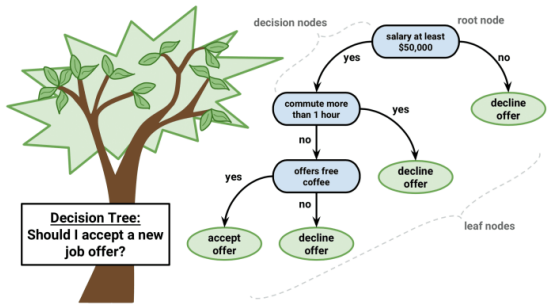


Two kinds of representation









Inductive logic programming

- Given background knowledge

```
parent(ann,mary).        female(ann).
parent(ann,tom).         female(mary).
parent(tom,eve).         female(eve).
```

- Given positive and negative information

```
+ daughter(mary,ann).    - daughter(tom,ann).
+ daughter(eve,tom).     - daughter(tom,eve).
```

- Induce relations

```
daughter(X,Y) :- parent(Y,X), female(X).
```

Inductive logic programming

- Given background knowledge

```
parent(ann,mary).        female(ann).
parent(ann,tom).         female(mary).
parent(tom,eve).         female(eve).
```

- Given positive and negative information

```
+ daughter(mary,ann).    - daughter(tom,ann).
+ daughter(eve,tom).     - daughter(tom,eve).
```

- Induce relations

```
daughter(X,Y) :- parent(Y,X), female(X).
```

Inductive logic programming

- Given background knowledge

```
parent(ann,mary).        female(ann).
parent(ann,tom).         female(mary).
parent(tom,eve).         female(eve).
```

- Given positive and negative information

```
+ daughter(mary,ann).    - daughter(tom,ann).
+ daughter(eve,tom).     - daughter(tom,eve).
```

- Induce relations

```
daughter(X,Y) :- parent(Y,X), female(X).
```

Inductive logic programming

- Given background knowledge

```
parent(ann,mary).        female(ann).
parent(ann,tom).         female(mary).
parent(tom,eve).         female(eve).
```

- Given positive and negative information

```
+ daughter(mary,ann).    - daughter(tom,ann).
+ daughter(eve,tom).     - daughter(tom,eve).
```

- Induce relations

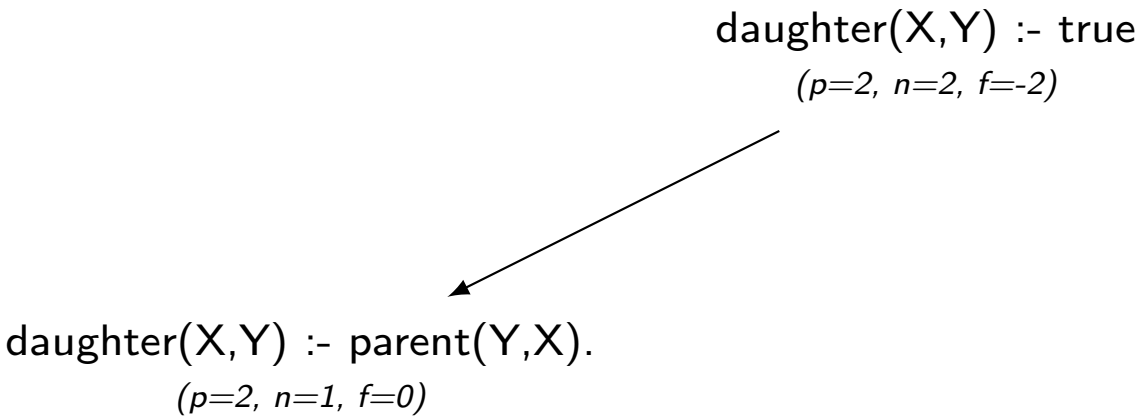
```
daughter(X,Y) :- parent(Y,X), female(X).
```

Basic strategy

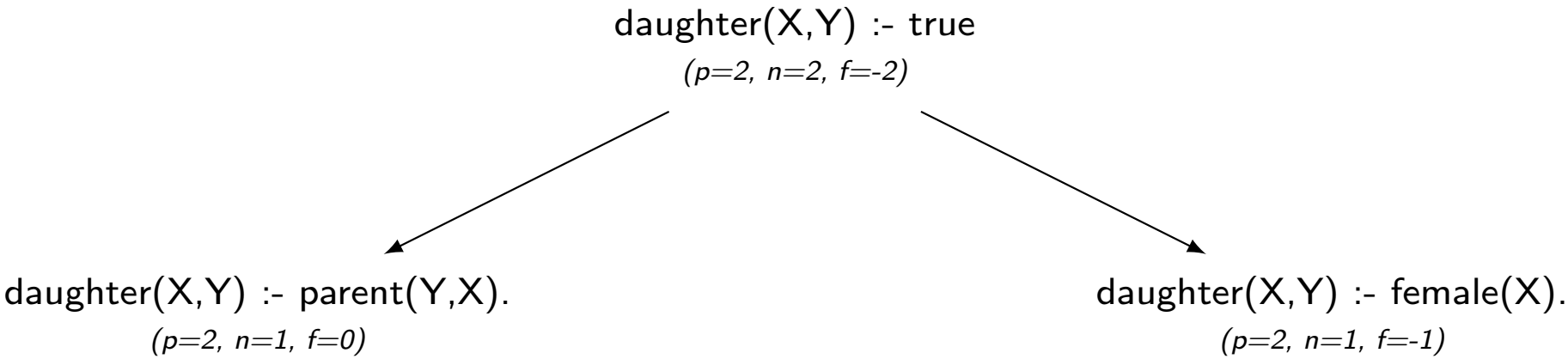
daughter(X,Y) :- true

(p=2, n=2, f=-2)

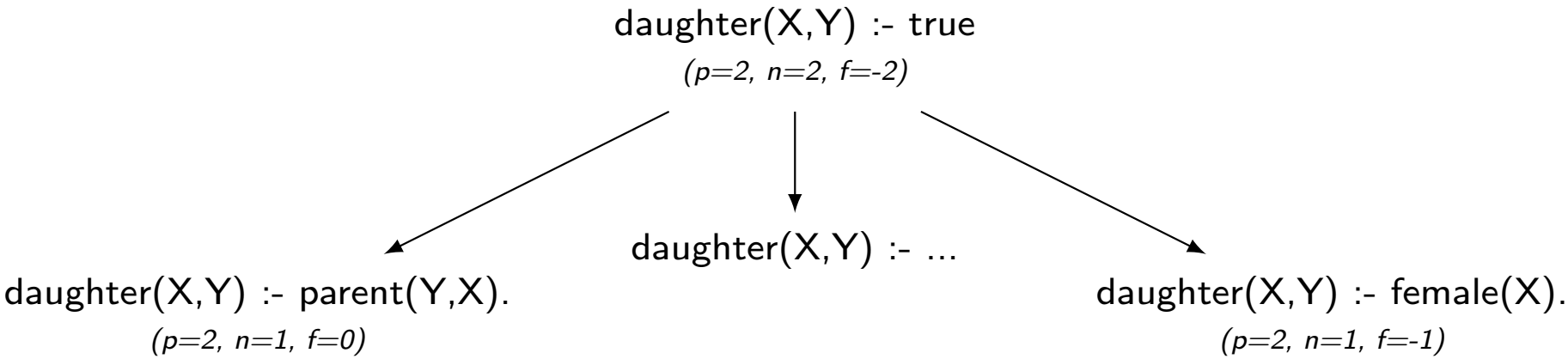
Basic strategy



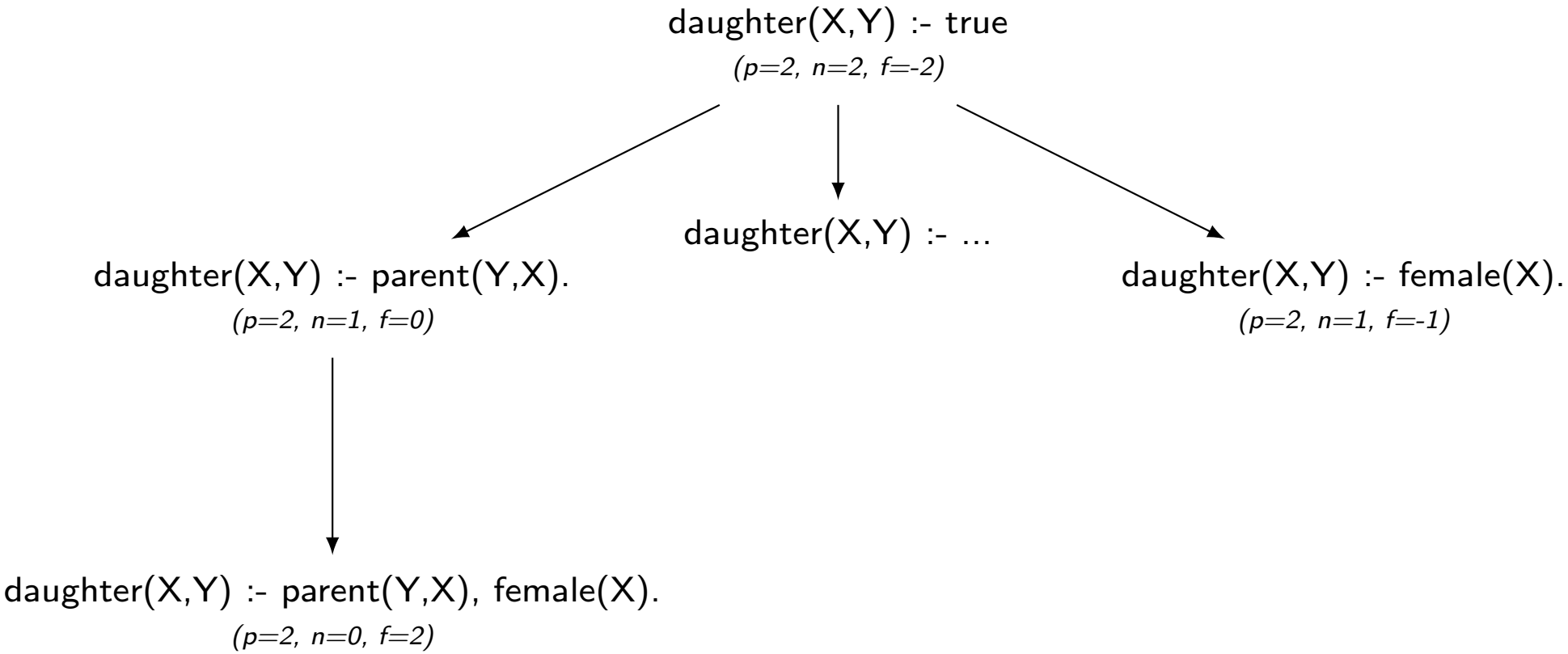
Basic strategy



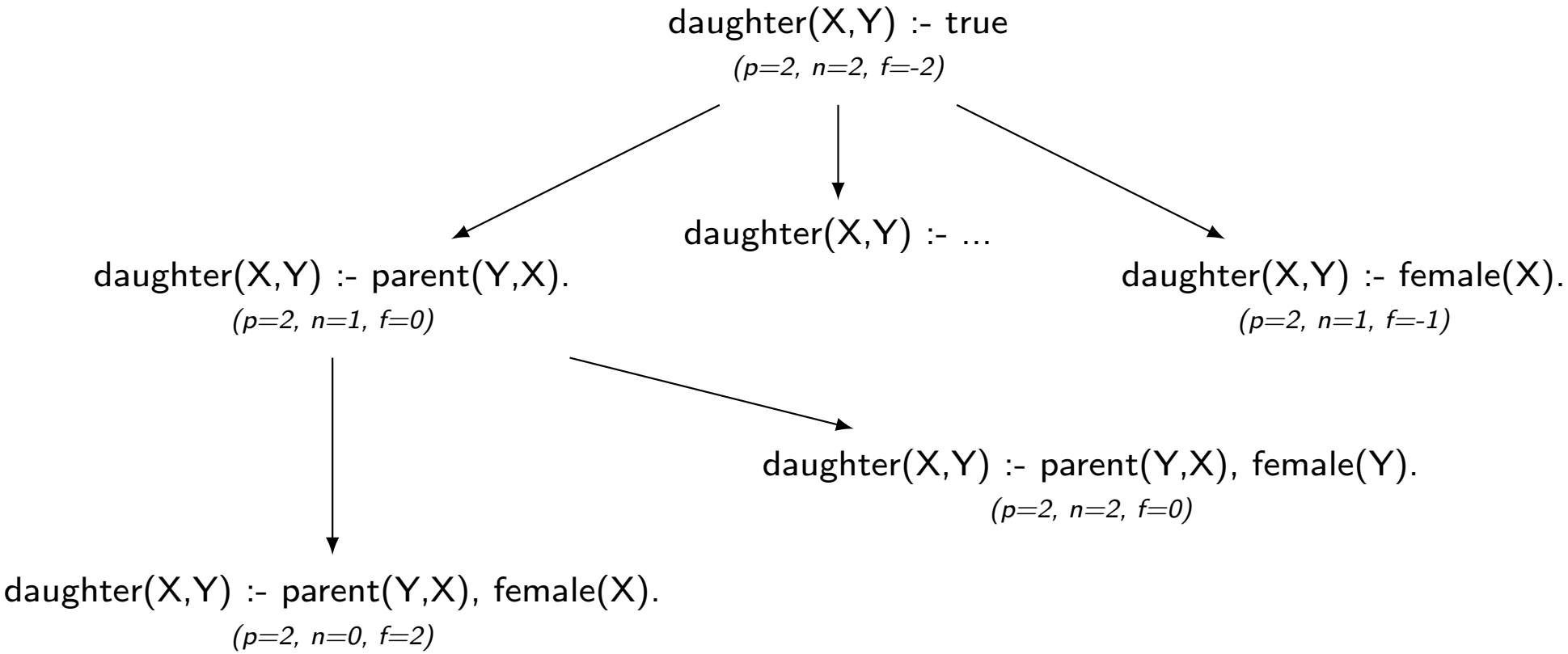
Basic strategy



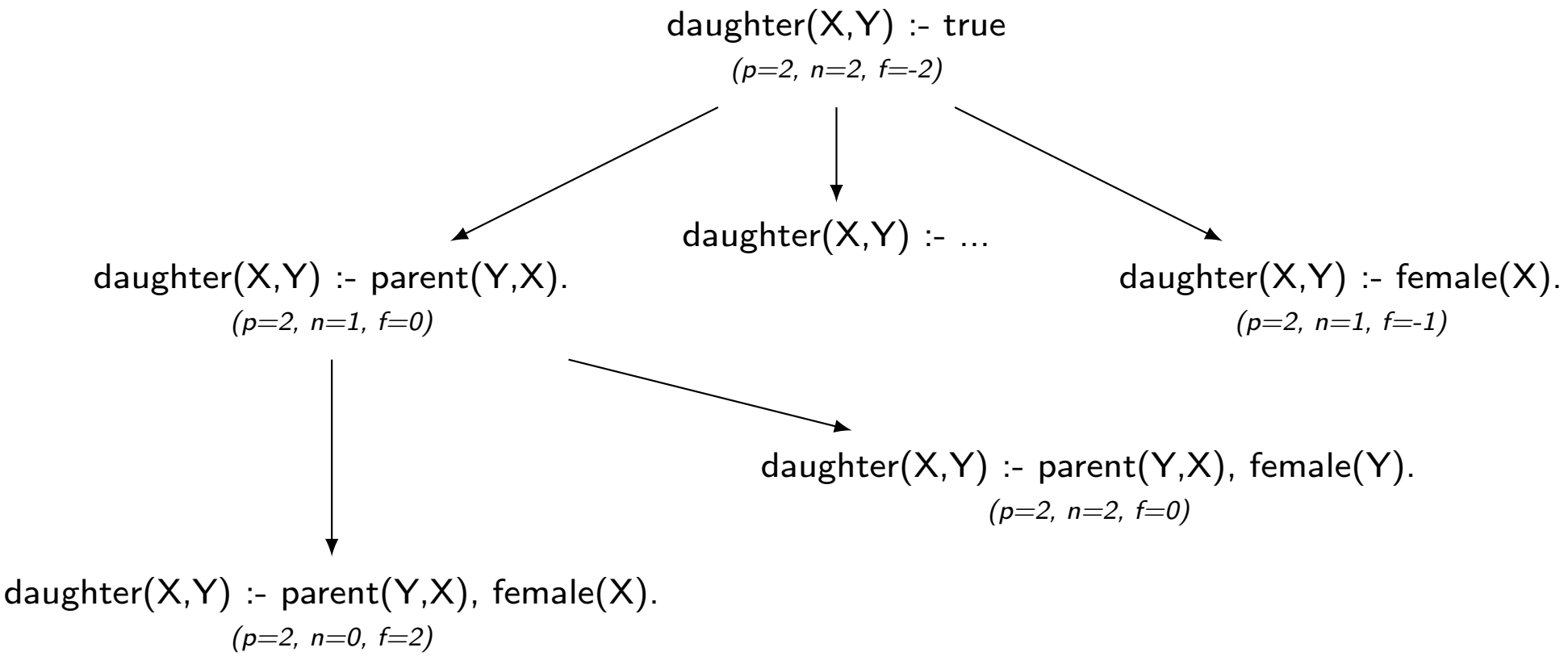
Basic strategy



Basic strategy



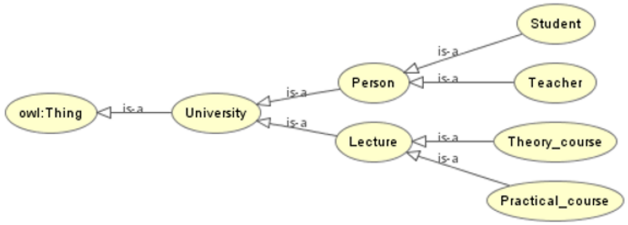
Basic strategy



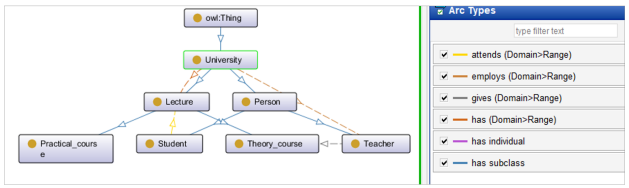
Key features

Incremental & theory-based

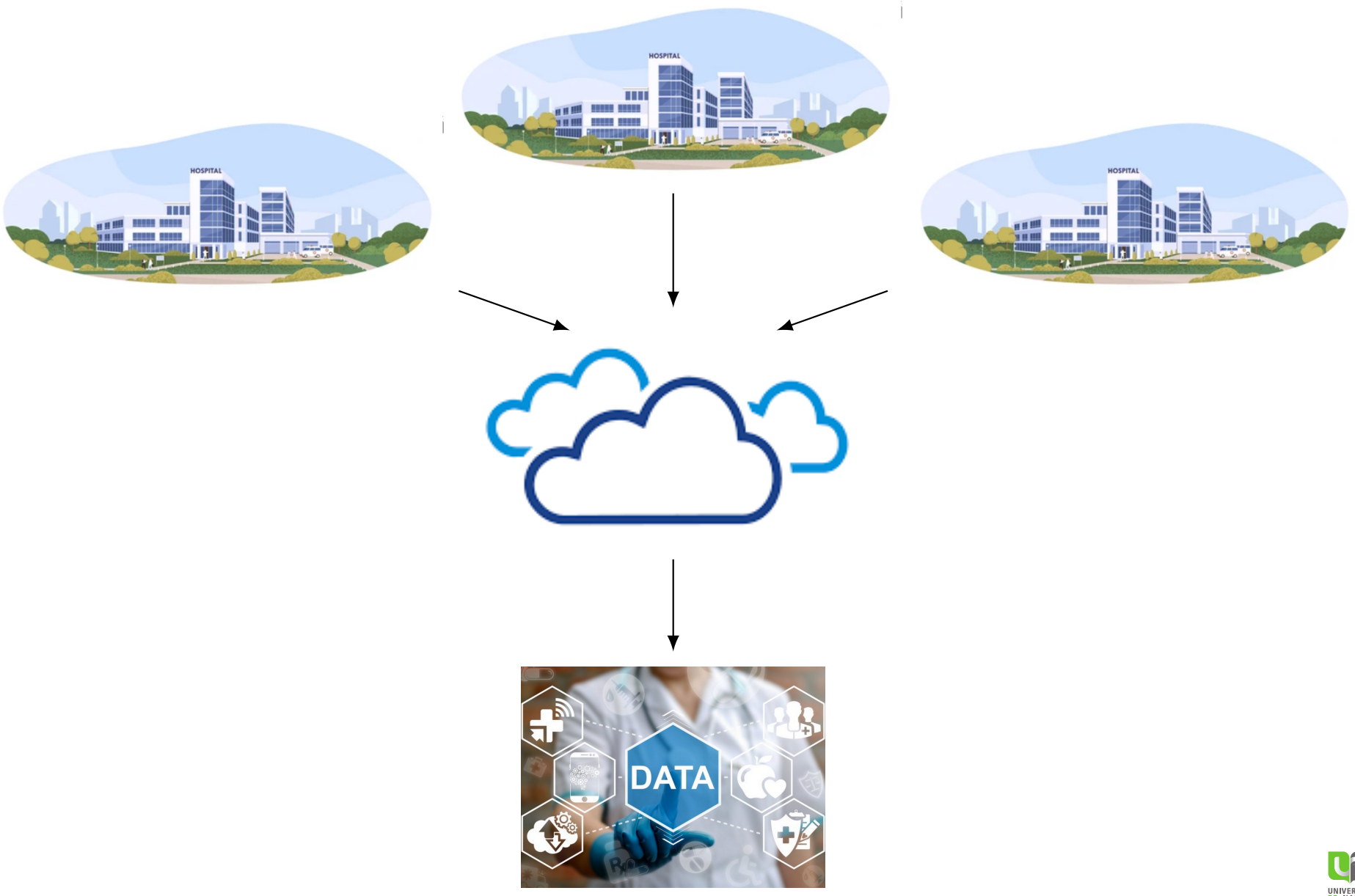
Ontologies



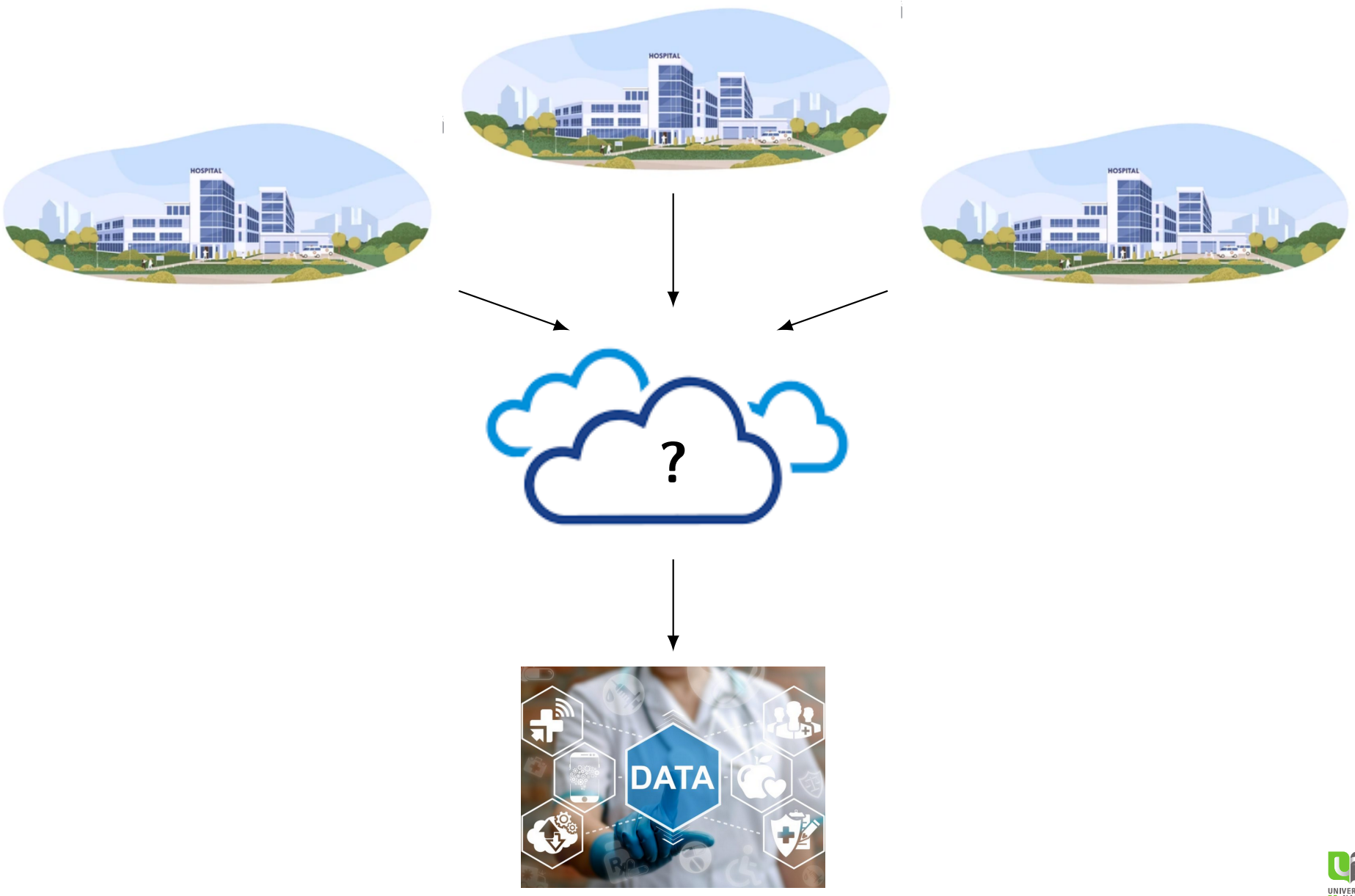
- Formal, Explicit and Shared Knowledge Models
  - Interoperability
  - Efficient communication between actors
  - Support formal checks
- at Various Levels: top-level, domain, task, application
- from Business Vocabulary to Formal Modelling
  - Classes, Relations, Axioms and Instances
  - Broadly used in Medical Domain
- Seminal Tools
  - Edition : Protégé
  - Implementation Language : OWL



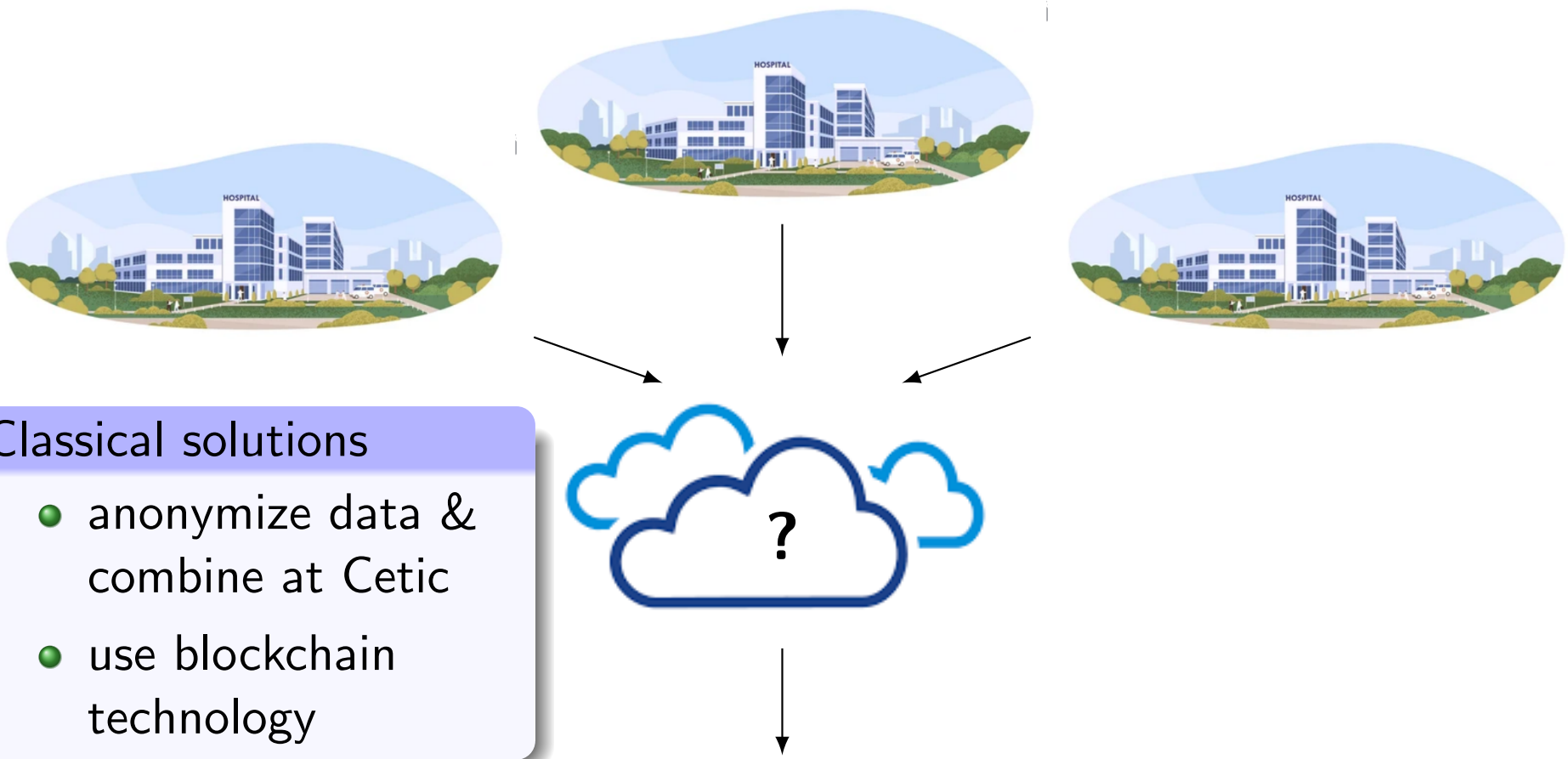
Federated learning, INAH and Challenge 3



Federated learning, INAH and Challenge 3



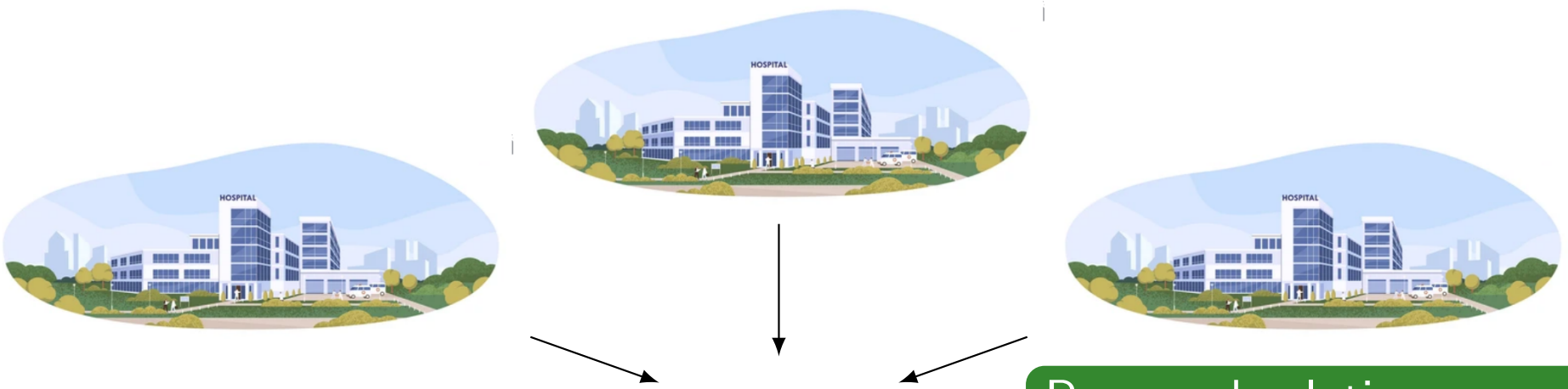
Federated learning, INAH and Challenge 3



Classical solutions

- anonymize data & combine at Cetic
- use blockchain technology

Federated learning, INAH and Challenge 3



Classical solutions

- anonymize data & combine at Cetic
- use blockchain technology

Proposed solution

- learn theories locally
- combine theories at Cetic
- employ ontologies