Programmation en Clogique

Lars Hupel
:clojureD
2020-02-29

INNOQ

```
(defne presentation [orateur]
  ([:lars]
    (fresh [questions]
      (blague :drole) #_(rire)
      (introduction :corelogic)
      (fonctions :cool)
      (audience questions)
      (repondre questions))))
```

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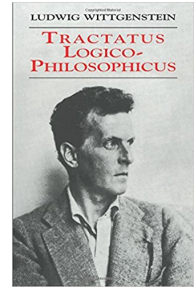
Who invented logic programming?

> *1. The world is everything that is the case.*
> *1.1 The world is the totality of facts, not of things.*
> *1.11 The world is determined by the facts, and by these being all the facts.*

Who invented logic programming?



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– Ludwig Wittgenstein, 1918

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Who invented Prolog?

- appeared in the early 70s in France
- original developers: Alain Colmerauer and Philippe Roussel
- used the `.pl` extension before Perl
- radically different programming paradigm
- this talk: using core.logic syntax

A brief primer on Prolog

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4. Programs can be queried.

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1. Prolog programs are sequences of **rules** (or **clauses**).
2. Rules can have arguments.
3. Rules can have conditions.
4. Programs can be queried.
5. Anything that is not in the program is not true.

Erlang, inspired by Prolog

> *The first interpreter was a simple Prolog meta interpreter which added the notion of a suspendable process to Prolog … [it] was rapidly modified (and re-written) …*
>
> – Armstrong, Virding, Williams: Use of Prolog for developing a new programming language

Hello World!

Program

```
(defn hi [])
```

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Interpreter

```
=> (run* (hi))
(_0)
```

Hello World!

Program

```
(defn hi [])


(defn hello [x]
  (== x :world))
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(:world)
```

A small program

Facts

```
(defne location [place in]
  ([:munich :germany])
  ([:augsburg :germany])
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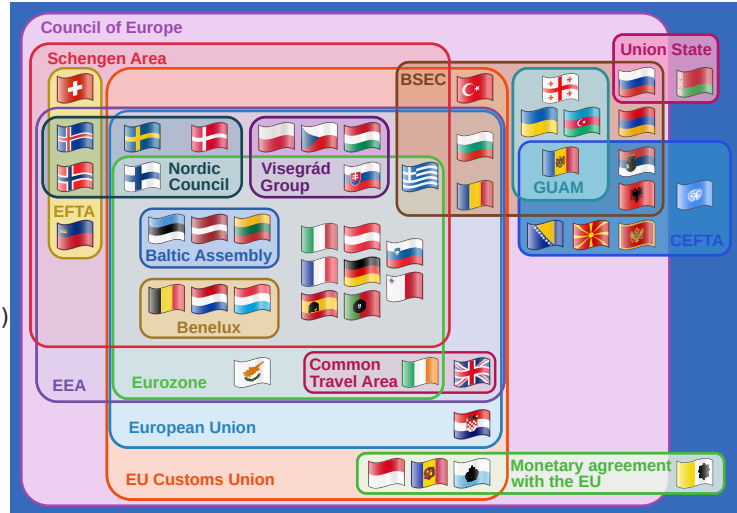

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Rules

```
(defn neighbour [x y]
  (fresh [z]
    (location x z)
    (location y z)))
```

A small program

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Rules

```
(defn is-in [x y]
  (conde
    [(location x y)]
    [(fresh (z)
        (location x z)
        (is-in z y))]))
```

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Backtracking

```
(defn best-boy [x]
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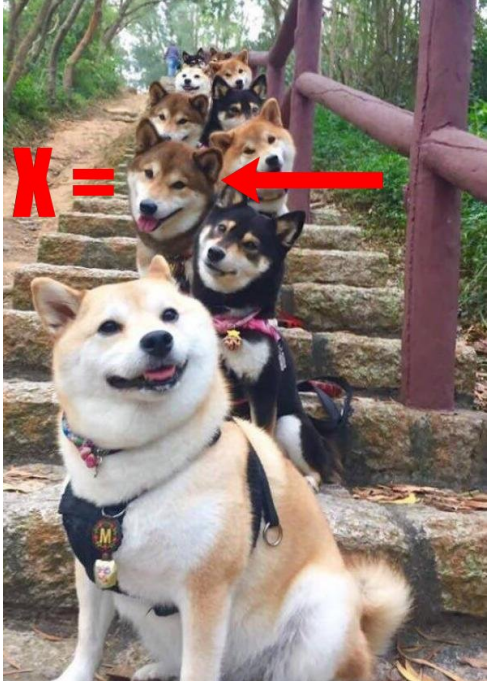

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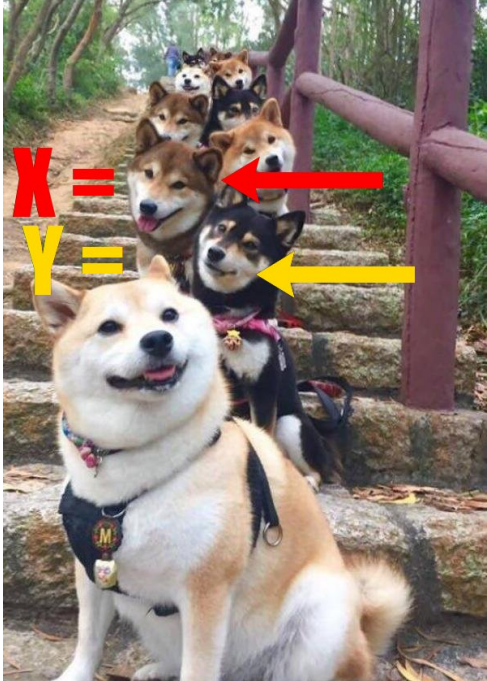

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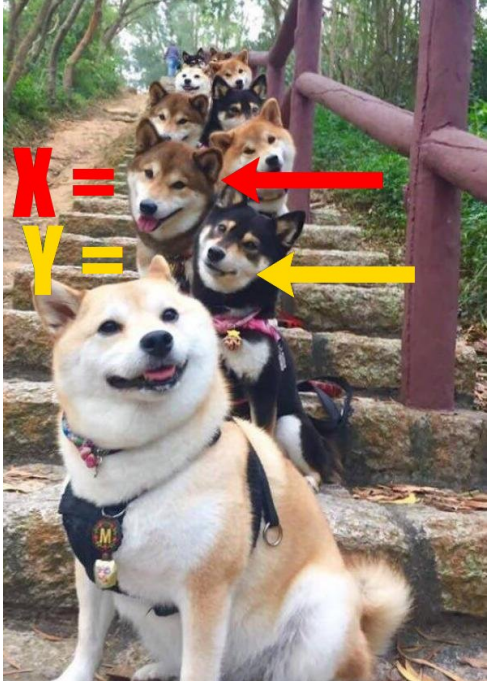

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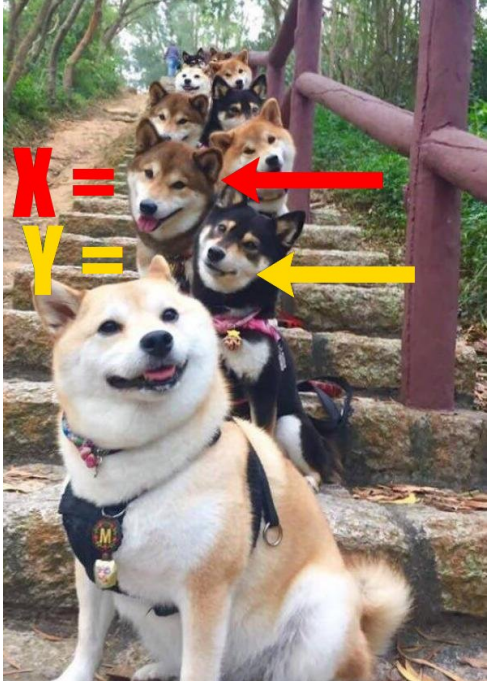

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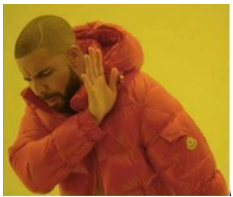
Bi-directional computing

$$f : I \rightarrow O$$

Bi-directional computing



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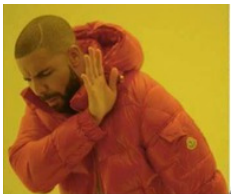
Bi-directional computing



$$f : I \rightarrow O$$

$$R : (I \times O) \rightarrow \{0, 1\}$$

Bi-directional computing

Clojure

```
(concat xs ys)
```

Bi-directional computing

Clojure

```
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```

core.logic

```
(appendo xs ys zs)
```

Not a silver bullet ...

How to reverse `flatten`?

What about numbers?

```
=> (run* [x y] (membero x [1 2 3]) (== y 2) (> x y))
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```
=> (require '[clojure.core.logic.fd :as fd])
=> (run* [x y] (membero x [1 2 3]) (== y 2) (fd/> x y))
([3 2])
```

Fact databases

How to model facts evolving over time?

Fact databases

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Self-modifying code? 🔥🤯😱

Fact databases

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Just like in SQL!

PLDB

```
(pldb/db-rel location p q)

(def facts
  (pldb/db
    [location :munich :germany]
    [location :augsburg :germany]
    [location :germany :europe]
    [location :london :unitedkingdom]
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```

PLDB as real database

- data model is similar to SQL: sets of tuples (“relations”)
- PLDB is static & immutable

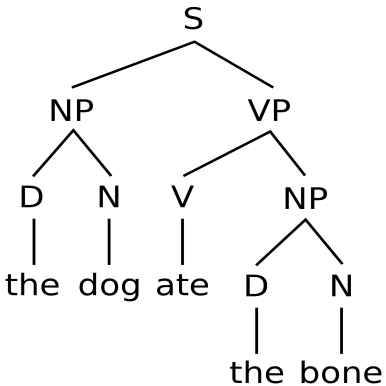
Constraint solving

Puzzle

There are five houses.

1. The English person lives in the red house.
2. The Swedish person owns a dog.
3. The Danish person likes to drink tea.
4. The green house is left to the white house.
5. The owner of the green house drinks coffee.
6. ...

Grammars



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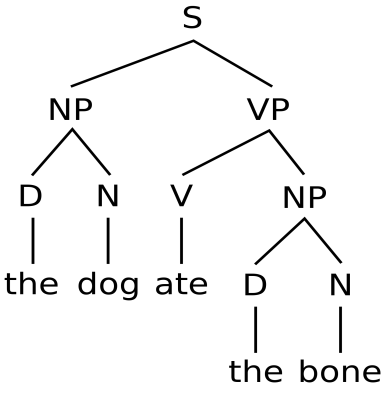

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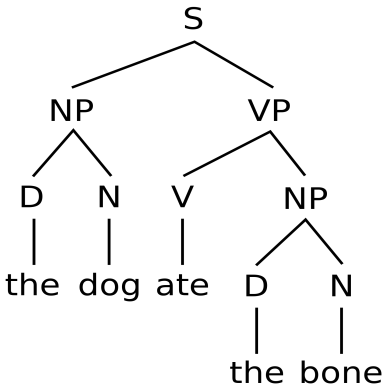

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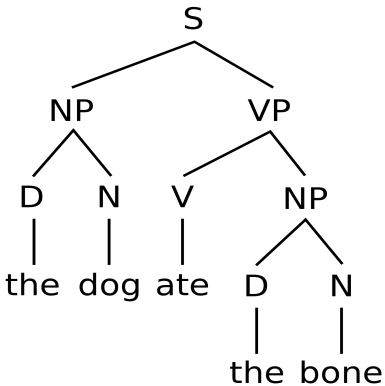


```
(def-->e det [d]
  ([[:d 'the]] '[the])
  ([[:d 'a]] '[a]))

(def-->e noun-phrase [n]
  ([[:np ?d ?n]]
   (det ?d) (noun ?n)))
```

Prolog is for parsing?

> *The programming language … was born of a project aimed not at producing a programming language but at processing natural languages; in this case, French.*
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Q & A

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LARS HUPEL

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Lars enjoys programming in a variety of languages, including Scala, Haskell, and Rust. He is known as a frequent conference speaker and one of the founders of the Typelevel initiative which is dedicated to providing principled, type-driven Scala libraries.

Image sources

- Title (map): https://pixabay.com/photos/world-europe-map-connections-1264062/
- Shiba row: https://www.pinterest.de/pin/424112489894679416/
- Shiba with mlem: https://www.reddit.com/r/mlem/comments/6tc1of/shibe_doing_a_mlem/
- Happy dog: https://www.rover.com/blog/is-my-dog-happy/
- Kid with crossed arms: https://www.psychologytoday.com/us/blog/spycatcher/201410/9-truths-exposing-myth-about-body-language
- Noam Chomsky: https://en.wikipedia.org/wiki/File:Noam_Chomsky_Toronto_2011.jpg
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- Joe Armstrong: Erlang, the Movie
- Signatures: http://www.swi-prolog.org/pldoc/man?section=preddesc
- Zebra puzzle: StackOverflow contributors (https://stackoverflow.com/q/11122814/4776939)
- Owl: https://www.theloop.ca/angry-owl-terrorizes-oregon-joggers/
- Clock: https://pixabay.com/photos/clock-alarm-alarm-clock-dial-time-1031503/
- Files: https://pixabay.com/photos/files-ddr-archive-1633406/