Programmation en Logique

Lars Hupel
Lambda Days
2019-02-21

INNOQ


PROLOG
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coffee bags: 100kr
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```
talk(lars) :-
  joke(funny), % laugh
  introduction(prolog),
  features(cool),
  audience(Questions),
  answer(Questions).
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Who invented Prolog?

> *1. The world is everything that is the case.*
> *1.1 The world is the totality of facts, not of things.*
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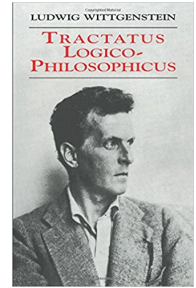
Who invented Prolog?



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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

A brief primer on Prolog

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Just like in SQL!

Hello World!

Program

```
hi.
```

Hello World!

Program

```
hi.
```

Interpreter

```
?- hi.
true.
```

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Program

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Variables: upper-case
Rest: lower-case

A small program

Facts

```
location(munich, germany).
location(augsburg, germany).
location(germany, europe).
location(london, unitedkingdom).
location(unitedkingdom, europe).
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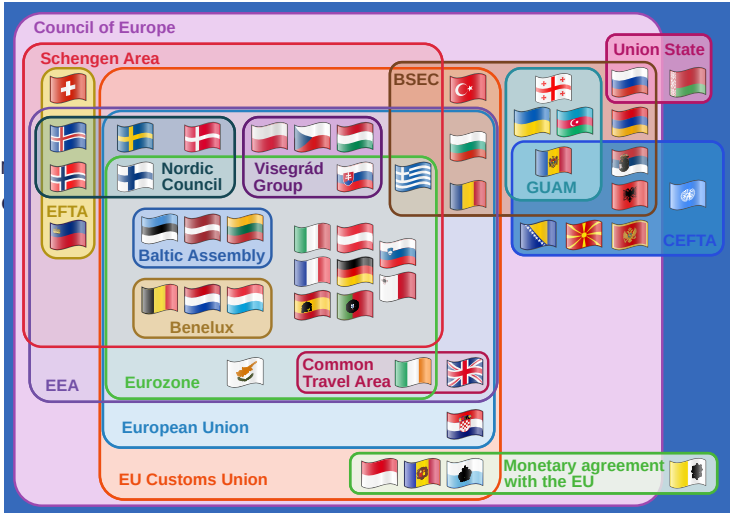

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Rules

```
neighbour(X, Y) :-
  location(X, Z), location(Y, Z).
```

A small program

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Rules

```
is_in(X, Y) :- location(X, Y).
is_in(X, Y) :- location(X, Z), is_in(Z, Y).
```

Prolog syntax

What's with the weird syntax?

Prolog syntax

What's with the weird syntax?

Is it stolen from Erlang?

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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

```
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  joke(funny), % laugh
  introduction(prolog),
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Backtracking

```
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  dog(good, X),
  colour(dark_brown, X),
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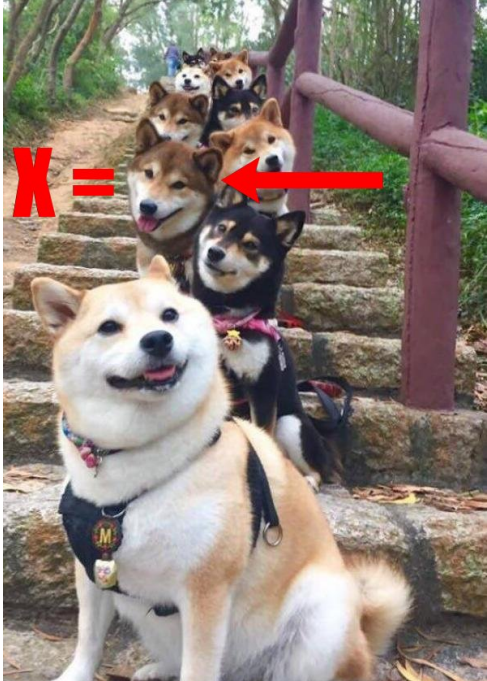

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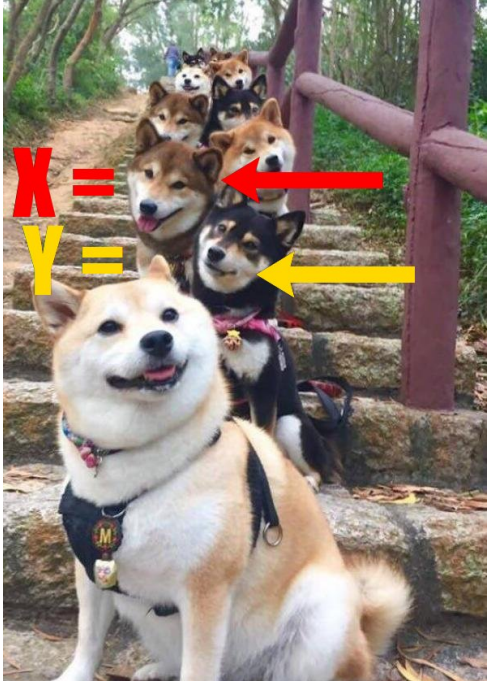

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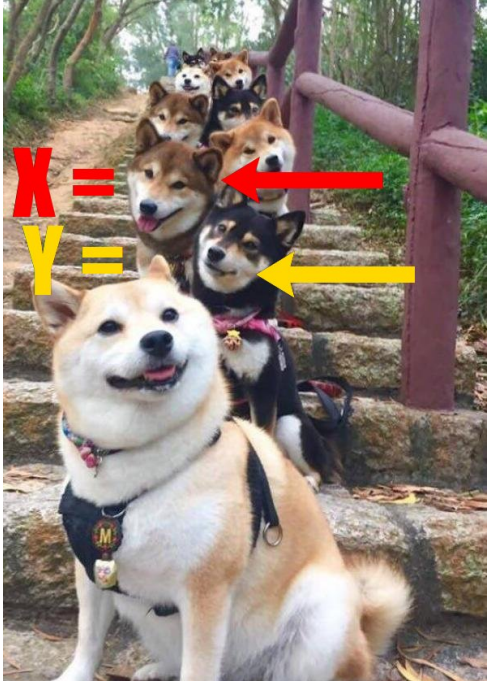

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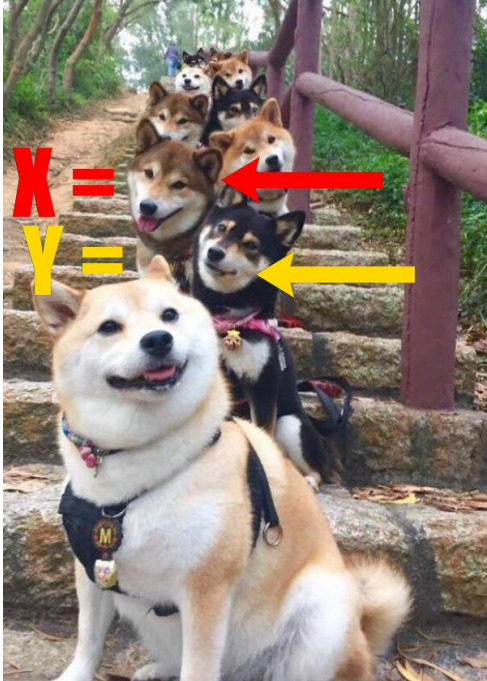

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Bi-directional computing

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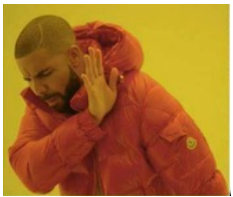

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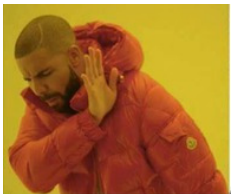

$$f : I \rightarrow O$$

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

Bi-directional computing

Scala

```
def append[A](xs: List[A], ys: List[A]): List[A]
```

Bi-directional computing

Scala

```
def append[A](xs: List[A], ys: List[A]): List[A]
```

Prolog

```
append(?List1, ?List2, ?List1AndList2)
```

Bi-directional computing

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```
def appendAll[A](xss: List[List[A]]): List[A]
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Bi-directional computing

Scala

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def appendAll[A](xss: List[List[A]]): List[A]
```

Prolog

```
append_all(+ListOfLists, ?List)
```

Mode signatures

++	Argument must be ground, i.e., the argument may not contain a variable anywhere.
+	Argument must be fully instantiated to a term that satisfies the type. This is not necessarily *ground*, e.g., the term `[_]` is a *list*, although its only member is unbound.
-	Argument is an *output* argument. Unless specified otherwise, output arguments need not to be unbound. For example, the goal `findall(X, Goal, [T])` is good style and equivalent to `findall(X, Goal, Xs), Xs = [T]`[45] Note that the *determinism* specification, e.g., ``det'' only applies if this argument is unbound.
--	Argument must be unbound. Typically used by predicates that create `something' and return a handle to the created object, such as open/3 which creates a *stream*.
?	Argument must be bound to a *partial term* of the indicated type. Note that a variable is a partial term for any type. Think of the argument as either *input* or *output* or *both* input and output. For example, in `stream_property(S, reposition(Bool))`, the `reposition` part of the term is input and the uninstantiated *Bool* is output.
:	Argument is a meta-argument. Implies +. See chapter 6 for more information on module handling.
@	Argument is not further instantiated. Typically used for type tests.
!	Argument contains a mutable structure that may be modified using setarg/3 or nb_setarg/3.

Not a silver bullet ...

```
?- member(X, [1, 2, 3]), Y = 2, X > Y.
X = 3, Y = 2.
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Not a silver bullet ...

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X = 3, Y = 2.
```

```
?- use_module(library(clpfd)).
?- X #> Y, X in 1..3, Y = 2.
```

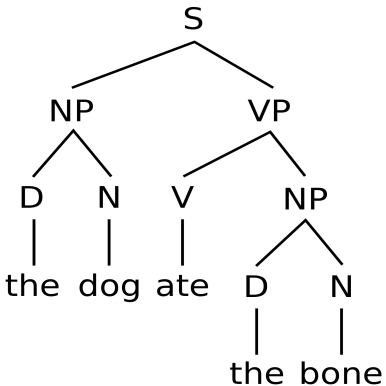
Constraint solving

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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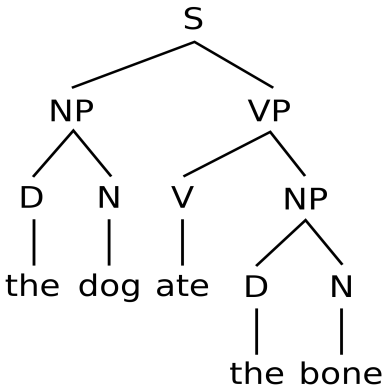

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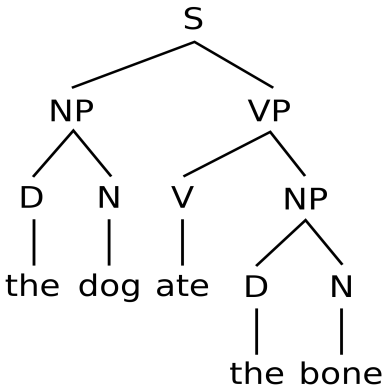

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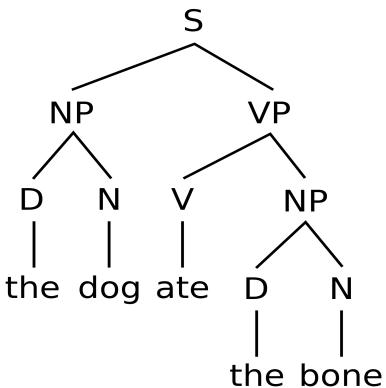


```
s --> np, vp.
np --> d, n.
d --> [the].
d --> [a].
vp --> v, np.
n --> [dog].
n --> [bone].
```

Prolog is for parsing?

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Parsing

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```
type Parser[A] = String => List[(A, String)]
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Prolog

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parse(?A, ?ListIn, ?ListOut)
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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

- Prolog coffee: Marek Kubica
- 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
- Alain Colmerauer: https://de.wikipedia.org/wiki/Datei:A-Colmerauer_web-800x423.jpg
- 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/