Towards an Implementation-Independent Interface for Reasoning about Semantic Web in Prolog

Hashimoto, Daniel Kiyoshi

3rd Scryer Prolog Meetup – November 2025
Hochschule Düsseldorf, Düsseldorf, Germany

Title Break Down

- Semantic Web

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- for Reasoning about … in Prolog

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The Web of Documents

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Prolog

59 languages

Article Talk Read Edit View history Tools

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This article is about the programming language. For the narrative device, see Prologue. For other uses, see Prologue (disambiguation).

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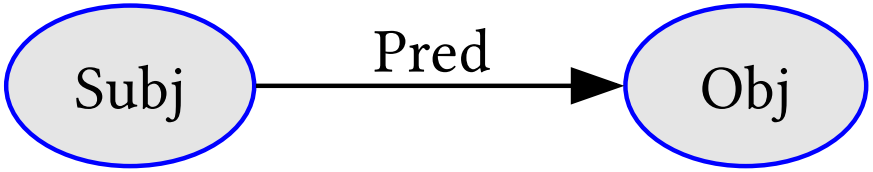

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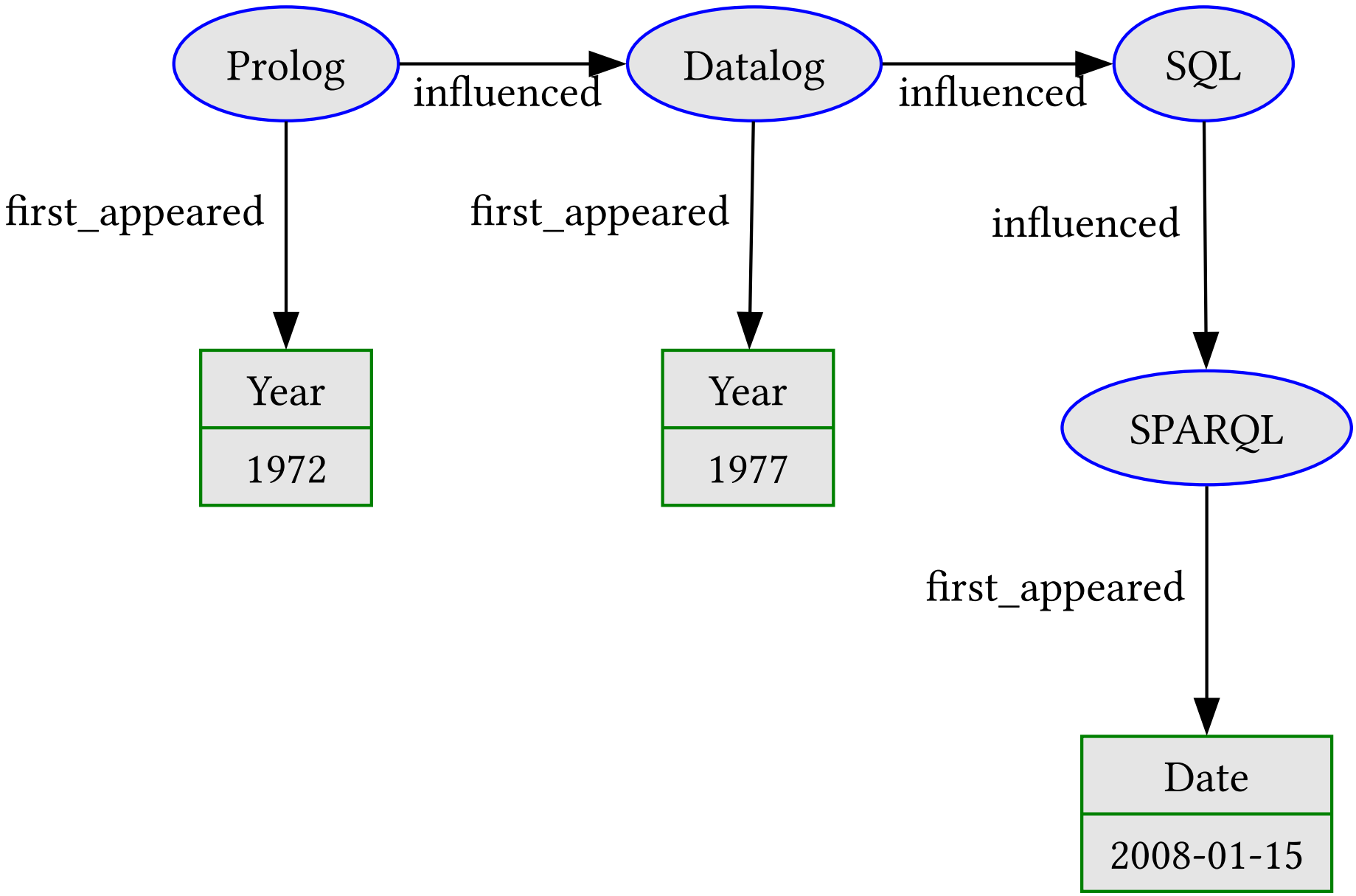
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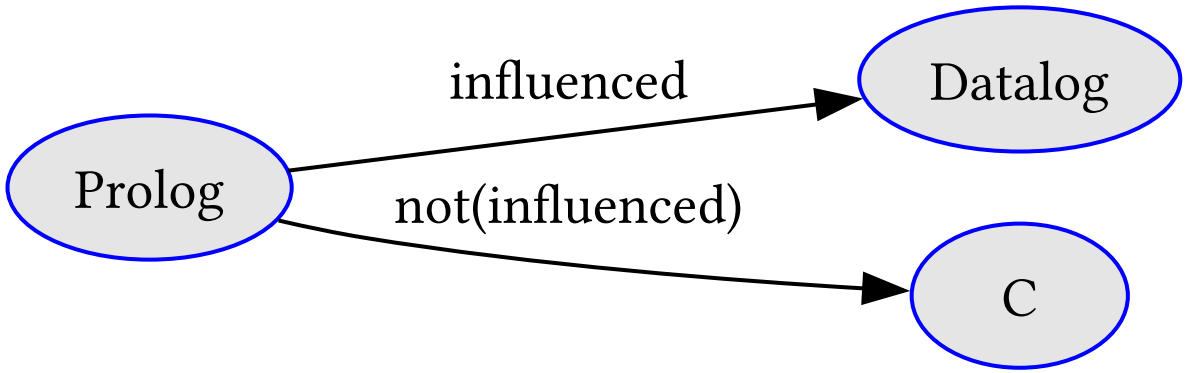

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Interface

Existing Libraries

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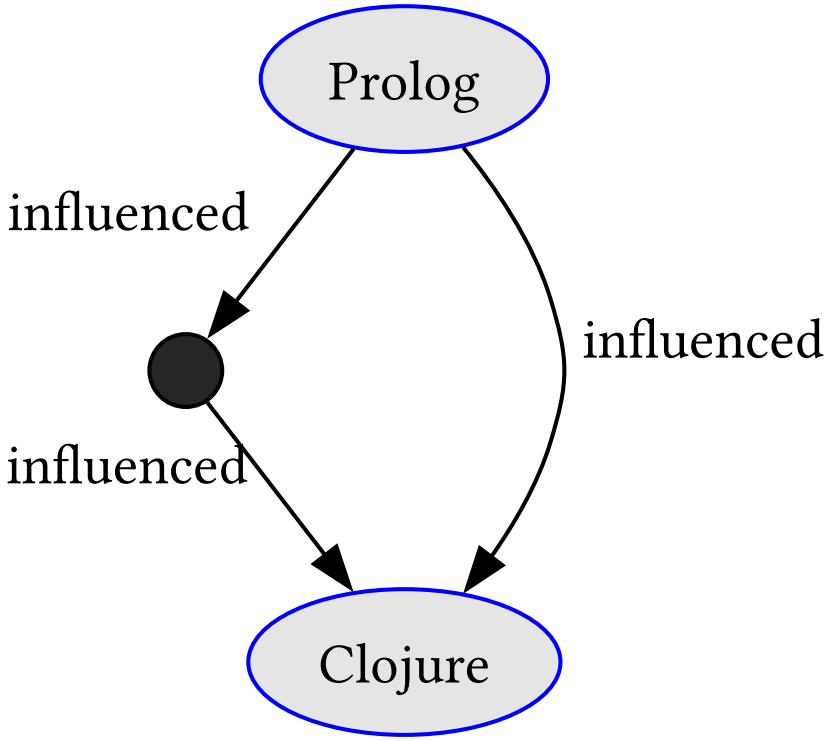

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`Ns:Frag` and `:(Frag)`	`wiki:prolog`, `:(prolog)`	readability	Namespaces and IRI collision

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`blank(Labeled, Name)`	`blank(labeled, '_:a')`, `blank(unlabeled, foo(bar, baz))`	more flexible, pattern matching

Literal representation

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literal(Lit)	`literal(1)`, `literal(@("prolog", "en"))`	close to prolog semantics

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literal(Lit)	`literal(1),` `literal(@("prolog", "en"))`	close to prolog semantics

literal(Type, Repr)
^^(Repr, Type)
	`literal(IntegerIRI, "1"),`
	`literal(IntegerIRI, "01"),`
	`literal(LangStrIRI, @("prolog", "en"))`
		closer to RDF semantics

Using IRI atoms representation:

```
1 IntegerIRI = 'http://www.w3.org/2001/XMLSchema#integer',
2 LangStrIRI = 'http://www.w3.org/1999/02/22-rdf-syntax-ns#langString'.
```

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Interface	Examples
assert/retract	`assert_axiom(prolog, influenced, datalog).`
(implicit graph)	`retract_axiom(prolog, influenced, datalog).`

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Interface	Examples
assert/retract (implicit graph)	`assert_axiom(prolog, influenced, datalog).` `retract_axiom(prolog, influenced, datalog).`
custom datatype (explicit graph)	`put_axiom(prolog, influenced, datalog, G0, G).` `del_axiom(prolog, influenced, datalog, G0, G).`

Explicit graph allows:

- working with multiple graphs
- set operations (union, intersection, minus, ...)

Interface	Example
inline queries	`?- Pred = influenced, rdf(prolog, Pred, X), rdf(X, Pred, Y).`

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inline queries	`?- Pred = influenced, rdf(prolog, Pred, X), rdf(X, Pred, Y).`
Domain Specific Language (similar to DCGs)	`?- Pred = influenced, query(( rdf(prolog, Pred, X), rdf(X, Pred, Y) )).`

DSL helps to achieve:

- load-time optimizations (`term_expansion/2` and `goal_expansion/2`)
- SPARQL translation (to and from)
  - federation queries

About My Library and Me

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Reference links for Semantic Web:

- `github.com/semantalytics/awesome-semantic-web`

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Research interests:

- alternative programming paradigms and computing models
- theorem proving and proof assistants
- static analysis/type systems/logic systems
- creating and using models
- “point at two things and saying ‘they are equal!’”

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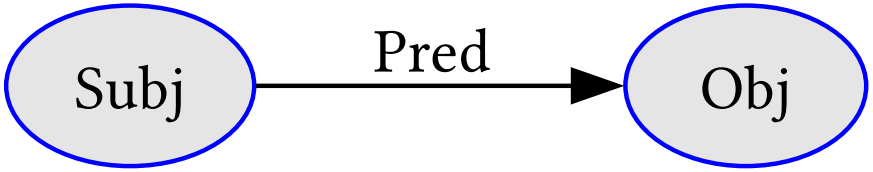

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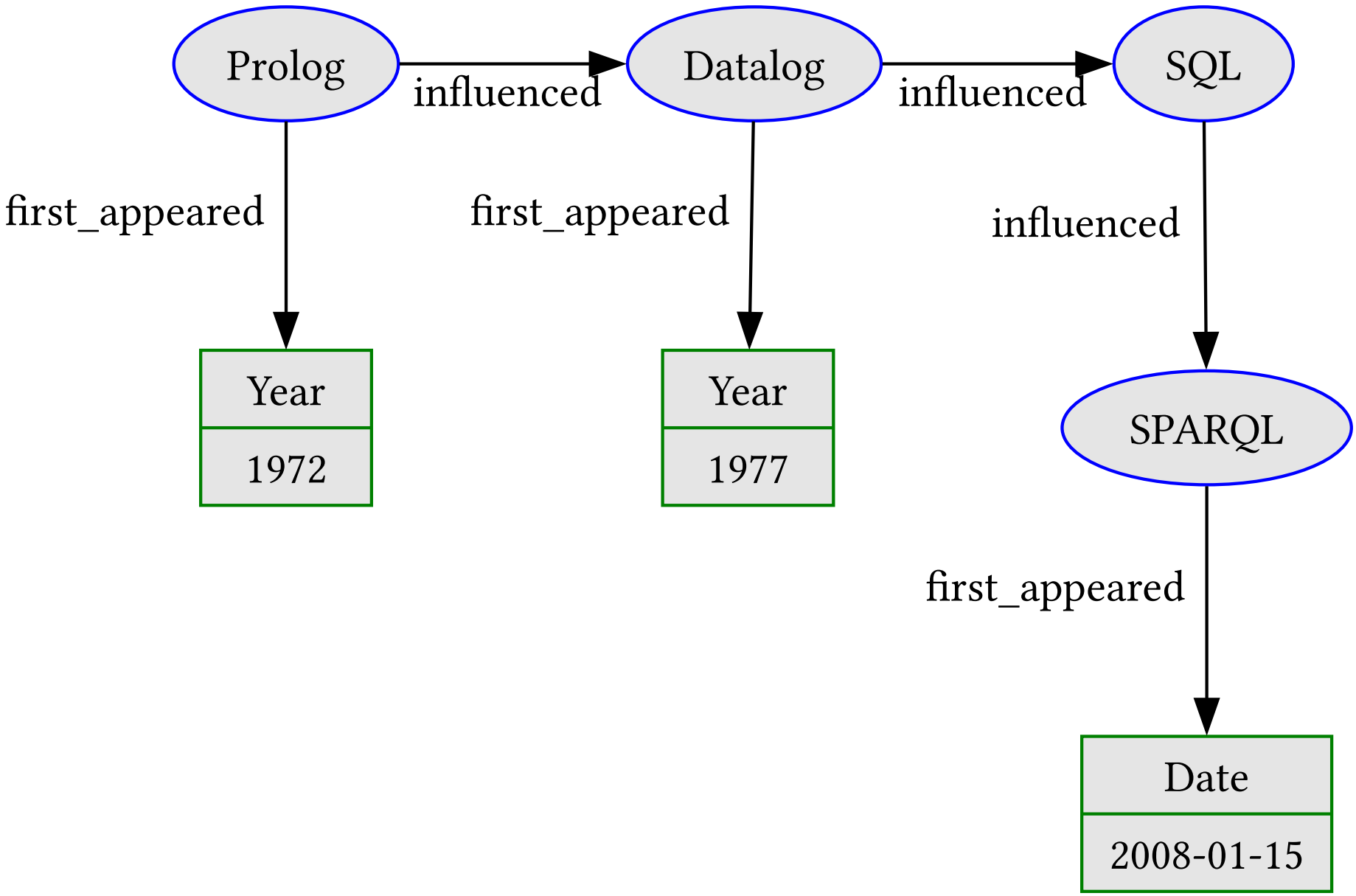
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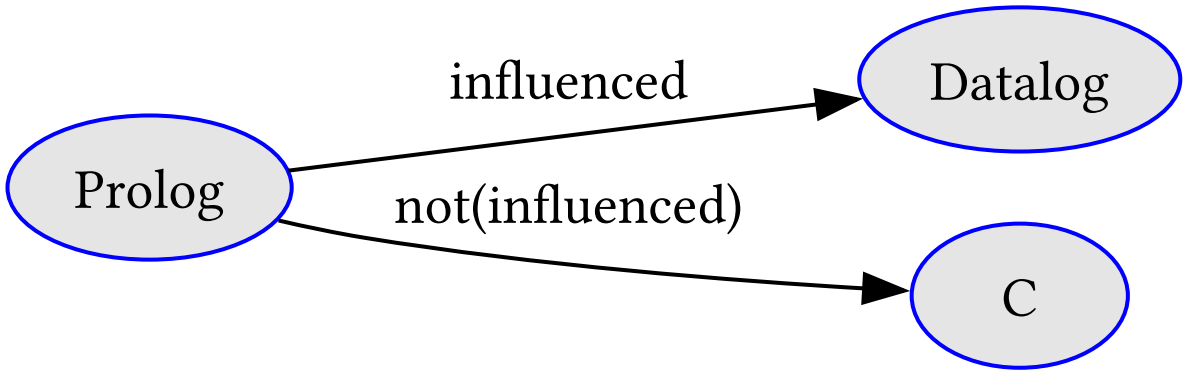

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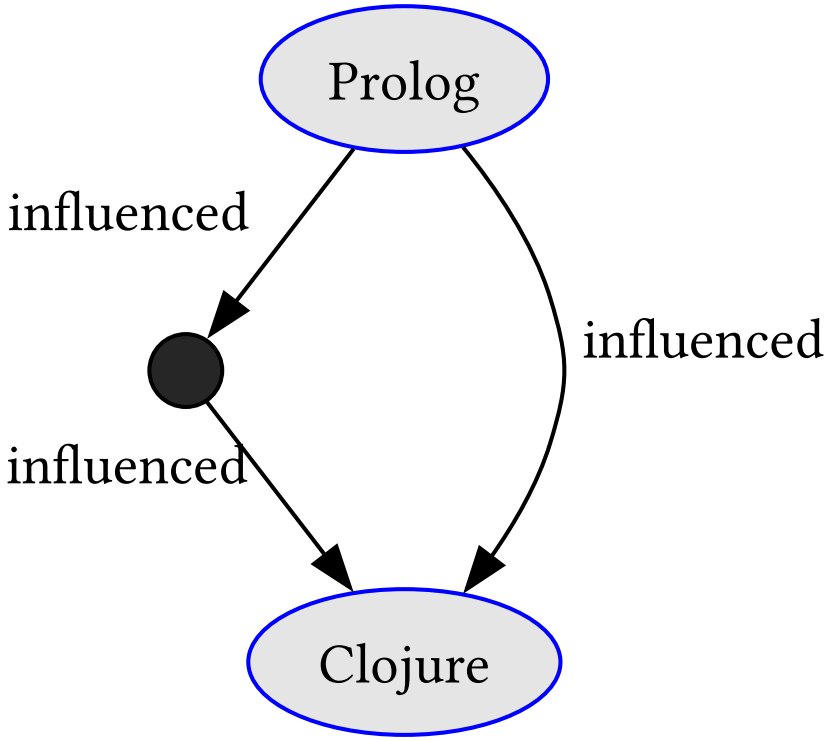

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literal(Lit)	`literal(1)`, `literal(@("prolog", "en"))`	close to prolog semantics
literal(Type, Repr) ^^(Repr, Type)	`literal(IntegerIRI, "1")`, `literal(IntegerIRI, "01")`, `literal(LangStrIRI, @("prolog", "en"))`	closer to RDF semantics

Using IRI atoms representation:

```
1 IntegerIRI = 'http://www.w3.org/2001/XMLSchema#integer',
2 LangStrIRI = 'http://www.w3.org/1999/02/22-rdf-syntax-ns#langString'.
```

A RDF Graph is a set of triples

Interface	Examples
assert/retract (implicit graph)	`assert_axiom(prolog, influenced, datalog).` `retract_axiom(prolog, influenced, datalog).`

A RDF Graph is a set of triples

Interface	Examples
assert/retract (implicit graph)	`assert_axiom(prolog, influenced, datalog).` `retract_axiom(prolog, influenced, datalog).`
custom datatype (explicit graph)	`put_axiom(prolog, influenced, datalog, G0, G).` `del_axiom(prolog, influenced, datalog, G0, G).`

Explicit graph allows:

- working with multiple graphs
- set operations (union, intersection, minus, ...)

Queries

Interface	Example
inline queries	`?- Pred = influenced, rdf(prolog, Pred, X), rdf(X, Pred, Y).`

Queries

Interface	Example
inline queries	`?- Pred = influenced, rdf(prolog, Pred, X), rdf(X, Pred, Y).`
Domain Specific Language (similar to DCGs)	`?- Pred = influenced, query(( rdf(prolog, Pred, X), rdf(X, Pred, Y) )).`

DSL helps to achieve:

- load-time optimizations (`term_expansion/2` and `goal_expansion/2`)
- SPARQL translation (to and from)
  - federation queries

About My Library and Me

About My Web Semantic Experience

Semantic Web Course (2025 March $\sim$ July)

- Late-undergraduate/Graduate level
- I wrote the Library in less than 3 weeks (final assignment)
  - unordered list of triples for the triple store
  - most of the implementation relies on `library(lists)` and `library(reif)`
- As far as I know, there are 0 users

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Reference links for Semantic Web:

- `github.com/semantalytics/awesome-semantic-web`

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- Formalizing connections between Applicative and Concatenative Tacit Programming
  - Combinatory Logic and Concatenative Calculus
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Research interests:

- alternative programming paradigms and computing models
- theorem proving and proof assistants
- static analysis/type systems/logic systems
- creating and using models
- “point at two things and saying ‘they are equal!’”