Design and Implementation of OO jDREW

Marcel A. Ball

OO jDREW

* Reasoning engine that was implemented. Includes:
  * Positional Prolog style logic
  * OO features from RuleML
    * Slots, Order-Sorted Types, oids
  * Implements a subset of the SWRL built-ins

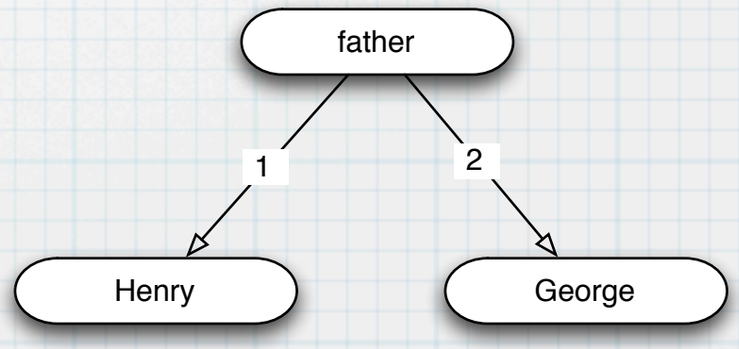
* Based to some extent upon Bruce Spencer's jDREW reasoning engine (www.jdrew.org)

Keyed Parameters (Slots)

* Allows for a non-positional knowledge representation
  * Useful for representing RDF descriptions

In a positional knowledge representation

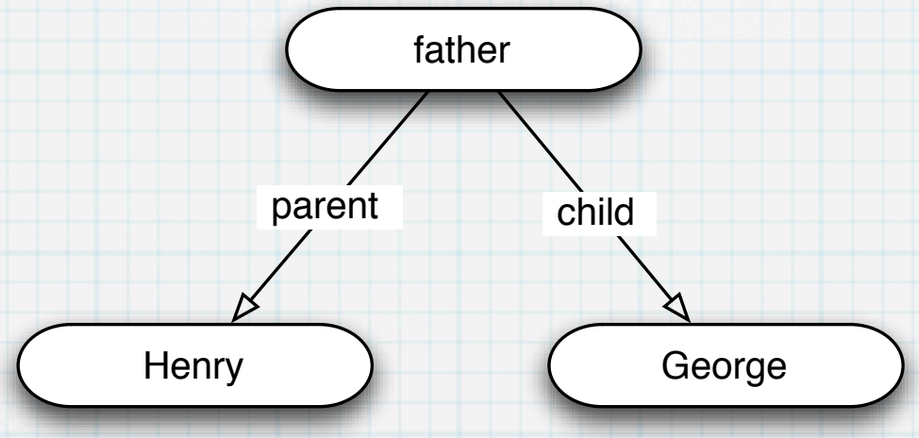
* Multiple possible interpretations
* Ordering of arguments is important




```
father(henry, george).
```

Keyed Parameters (Slots)

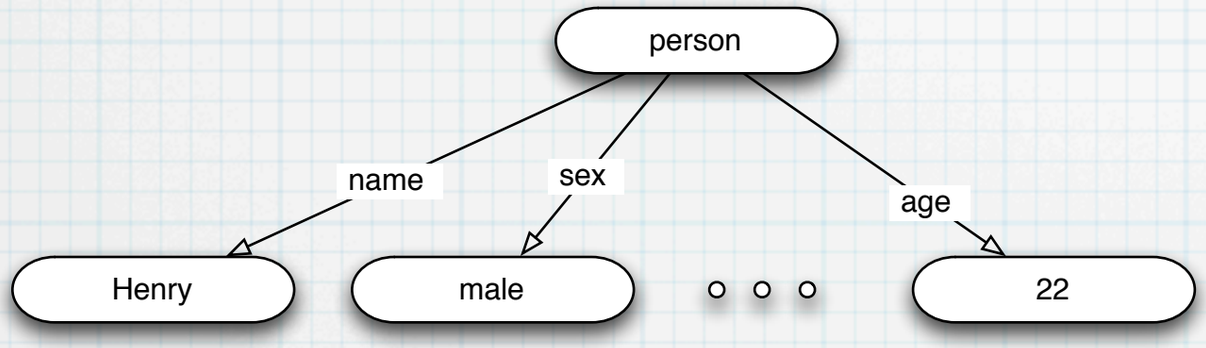
* Slotted version is unambiguous
* Order is no longer important




```
father(parent->Henry; child->George).
```

* Canonical order is imposed internally to make unification efficient

Keyed Parameters & Rest Variables

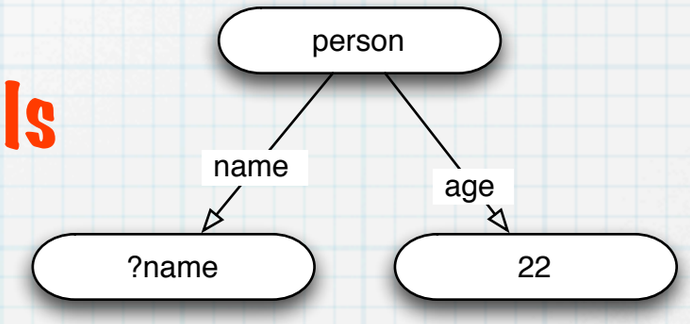



```
person(name->Henry; sex->male; ...; age->22).
```

Fact

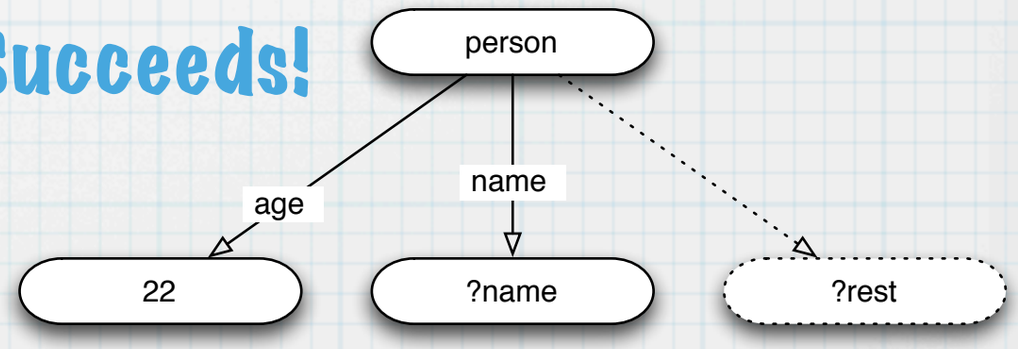
Queries

Fails




```
person(name->?name; age->22).
```

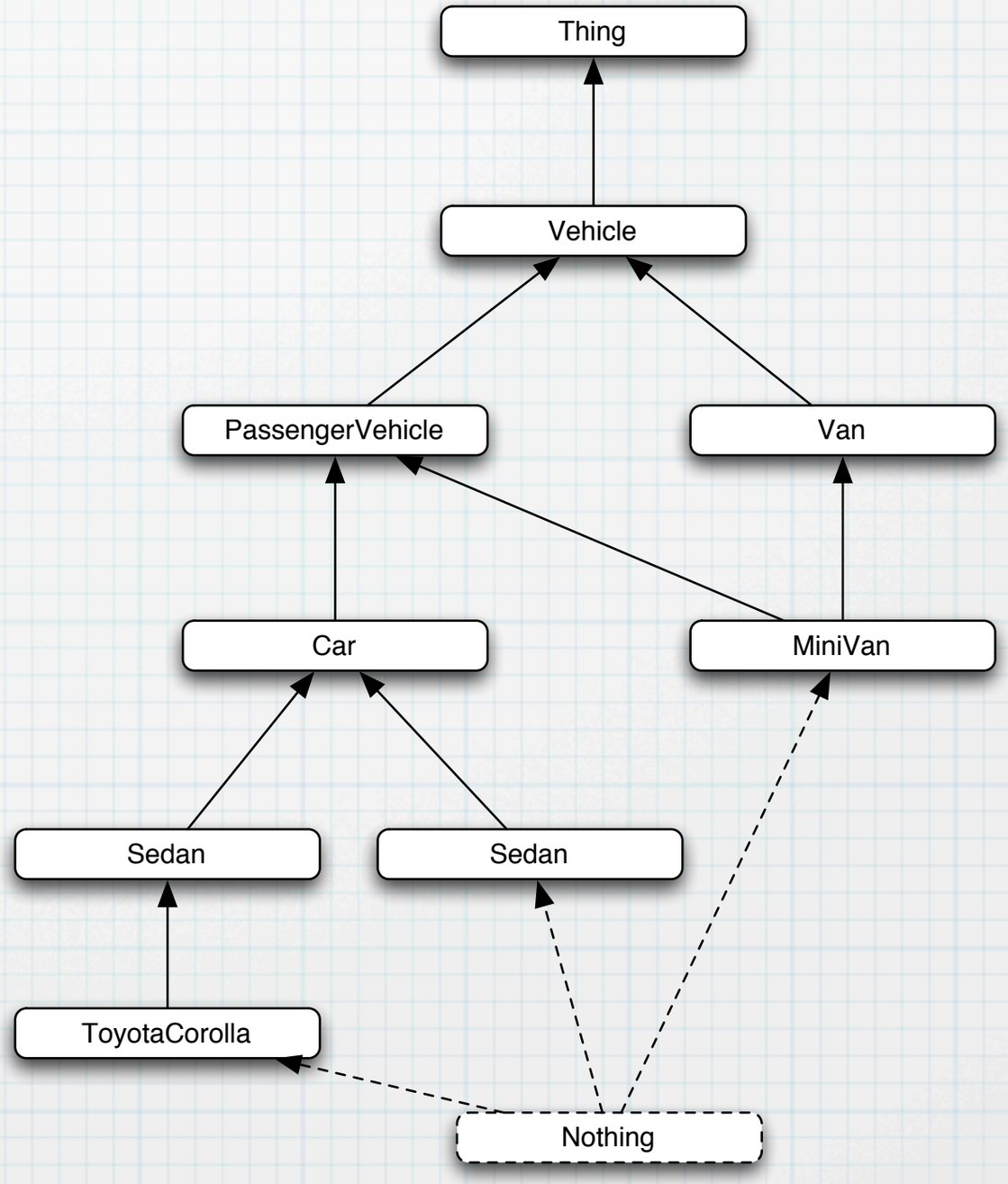
Succeeds!




```
person(age->22; name->?name !?rest).
```

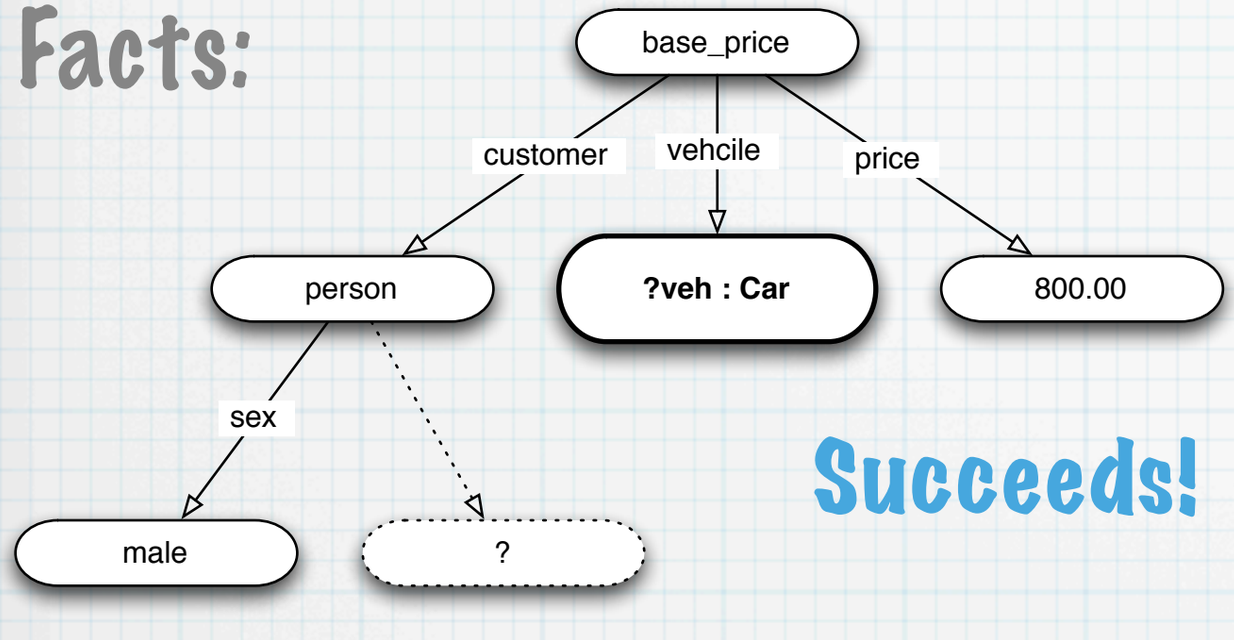
Order-Sorted Types

* Type sorts encoded in RDF Schema
* Internally represented as a lattice
* Type operations computed using lattice algorithms

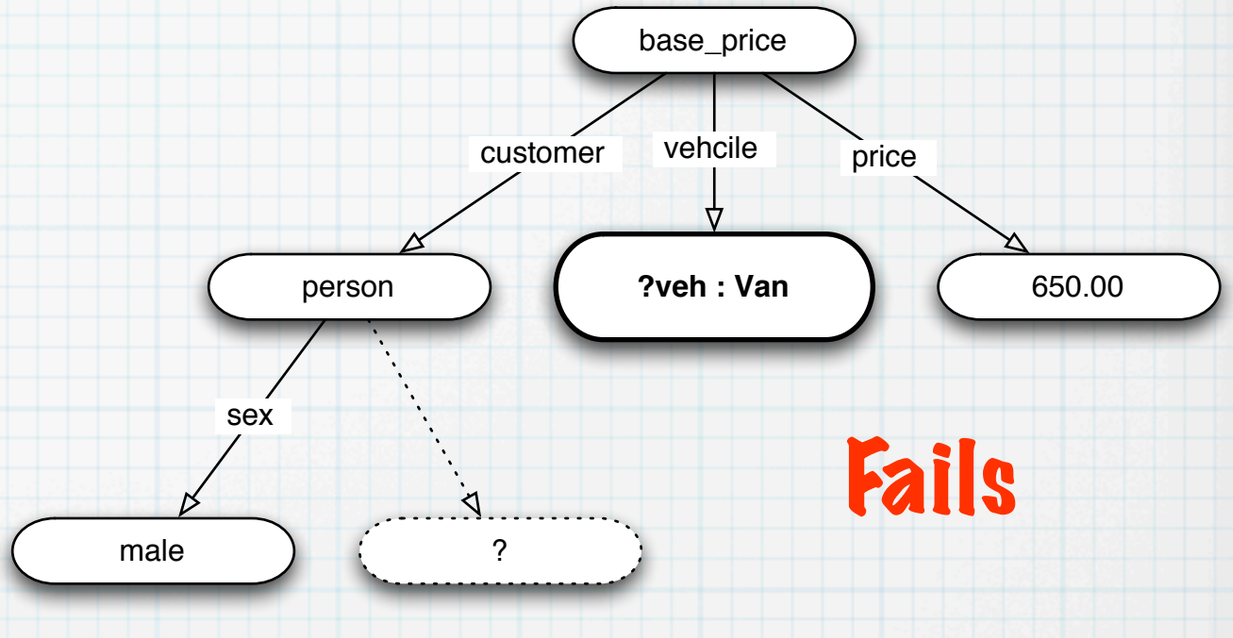


Order-Sorted Types Example

Facts:

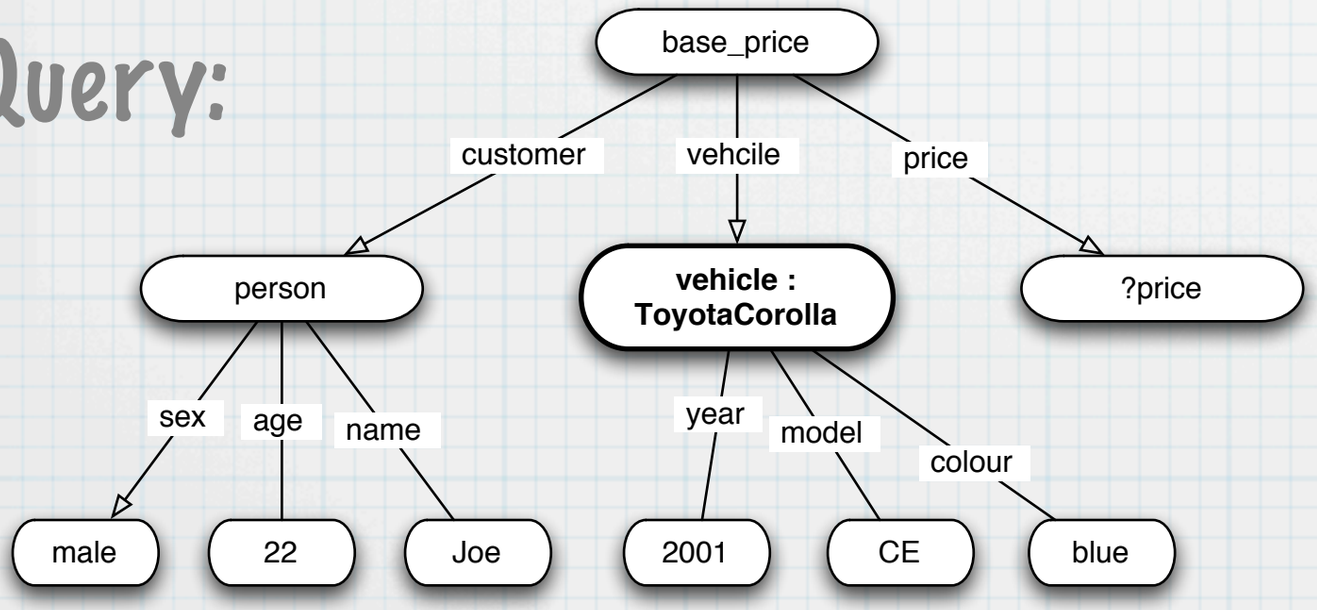


Succeeds!



Fails

Query:



Vehicle type is "ToyotaCorolla"

Inheritance path:
ToyotaCorolla -> Sedan -> Car -> Vehicle -> Thing

Order-Sorted Types

* Basic order-sorted types can be reduced to extra unary predicates called in the body
  * More complex representation
  * More resolution steps, leads to slower inferences

Time comparison of built-in sorts with unary predicates

	OO jDREW with built-in order-sorted types	OO jDREW with unary predicates
Average Time	256 ms	473 ms

Object Identifiers (oids)

* Allows unique identification of facts
  * Makes finding possible facts quicker if oid is known and specified in a goal
  * Like sending a message to a specified object

* Does not affect the main unification algorithm - only affects the search for matching clauses

Built-in Relations

* Many relations cannot be expressed as a finite set of facts and rules
  * This requires having a system for built-in relations
* Two goals of the Built-in system:
  * Easily expandable without detailed knowledge of the system
  * Common built-in relations included within engine
    * OO jDREW implements subset of SWRL built-ins

Future Work

* Improved Indexing System
  * Currently only indexed by relation name and oid (to ensure uniqueness)
    * Possible to create an indexing system based upon Discrimination Trees
* Improved Typing System
  * Currently only models taxonomic relationships

Conclusions and Questions

* The developed engine is able to use the combined positional/Object-Oriented RuleML
  * Work in progress on an advanced indexing system that may improve scaleability for large knowledge bases
  * URIs as oids are not currently implemented (difficulties with normalizing URIs)
* Available online at http://www.jdrew.org/oojdrew/