RECON – A Controlled English for Business Rules

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July 12th, 2013

What is RECON?

Dictionary & Vocabulary

Examples, examples, examples

Summary

How NIST became interested in Controlled English

- Requirements:
  - Represent domain experts knowledge about complex domain
  - Apply automatic reasoning
- Challenge: Find KR language that is
  - Semantically unambiguous
  - Highly expressive
  - Easy to learn and use for domain experts

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- Solution: restricted English $\overset{\text{compile}}{\rightarrow}$ logic language

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- Solution: RECON language $\overset{\text{compile}}{\rightarrow}$ logic language IKL

Example: RECON $\overset{\text{compile}}{\rightarrow}$ IKL

RECON Every person who attends RuleML is located in Seattle.

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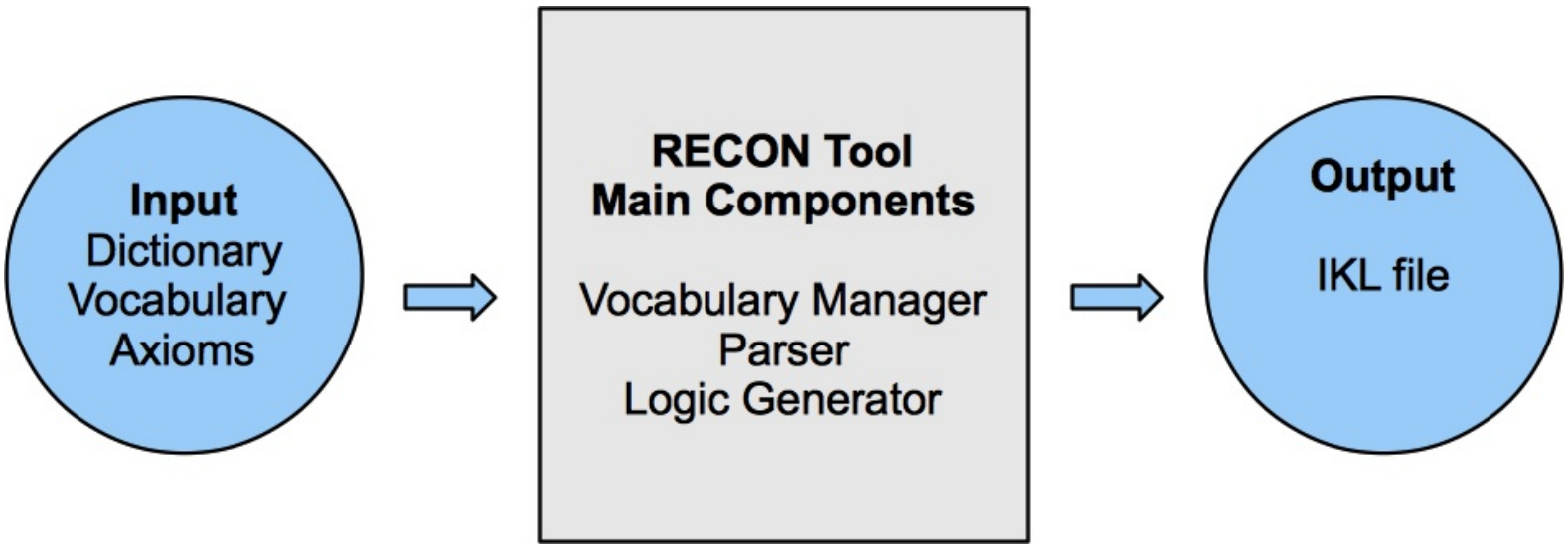
IKL
```
(forall (?person1)
  (if
    (and
      (person ?person1)
      (person.attends.conference ?person1 RuleML)
    )
    (person.is_located_in.thing ?person1 Seattle)
  ))
```

The big picture



Features of Approach

- Based on English words and usage
  - Reads like English
  - Supports domain vocabularies
- Formal grammar
  - strongly limits freedom of expression
  - unique parse
  - unique translation to IKL
- Writing the language requires training

IKL

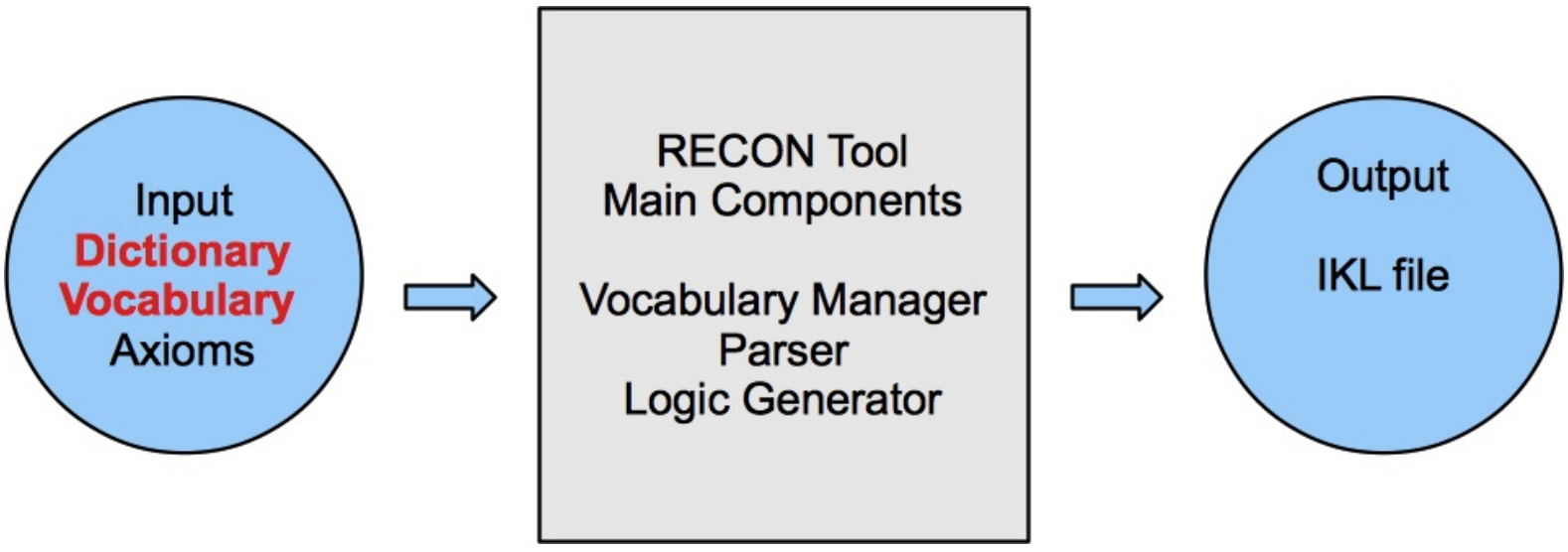
- Extension of ISO Common Logic by Pat Hayes & Chris Menzel
- (Syntactically) Higher-order logic
- Nominalized propositions (e.g. ‘that it rains’)
- Enables ‘modal’ expressions (e.g. ‘It is required that the field is watered’)

RECON vs. SBVR

- Both expressive languages
- RECON semantics = mapping to IKL $\circ$ IKL model theory
- SBVR has no formal semantics

Dictionary & Vocabulary

Reminder


Input
Dictionary
Vocabulary
Axioms
RECON Tool
Main Components
Vocabulary Manager
Parser
Logic Generator
Output
IKL file

Dictionary

- Dictionary consists of word forms
- No semantics
- Example for dictionary entry
  Dictionary Verb: run runs ran running run

Vocabulary

- Vocabulary = collection of terminological entries
- Terminological entry = collection of declarations
  - Primary term (mandatory)
  - Alternative forms
  - (Formal) definitions in RECON language
  - Free text definitions / comments
- Terminological entry belongs to a syntactic category

Example Vocabulary

Name: `Bride of Neptune`
Type Noun: `tanker`
Mass Noun: `gasoline`
Adjective: `(thing) is registered`
Verb: `(party) ships (shipment)`
    Alternative: `(shipment) is shipped by (party)`
Property: `(party) is the supplier () for (shipment)`
Unit: `gallon: volume`

Examples, examples, examples

Example: Simple sentence

Bride of Neptune is a registered tanker.

```
(exists (?tanker1)
  (and
    (and
      (tanker ?tanker1)
      (thing.is_registered ?tanker1))
    (= Bride_of_Neptune ?tanker1)))
```

Example: Quantification

Every supplier ships some shipment.

```
(forall (?supplier1)
  (if
    (supplier ?supplier1)
    (exists (?shipment2)
      (and
        (shipment ?shipment2)
        (party.ships.shipment ?supplier1 ?shipment2)
      ))))
```

Examples: Connectives

Connectives are allowed both between sentences and noun phrases

- ACME is registered or ACME is not registered.
- ACME owns both Bride of Neptune and Titanic.

Example: Qualifiers

Any shipment that is shipped via Bride of Neptune is registered.

```
(forall (?shipment1)
  (if
    (and
      (shipment ?shipment1)
      (shipment.is_shipped_via.vessel
       ?shipment1 Bride_of_Neptune))
    (thing.is_registered ?shipment1)))
```

Examples: Properties – dual nature

ACME is the supplier for SH12345. [verb]
The supplier for SH12345 ships SH12345. [noun]

```
(forall (?thing1)
  (if
    (and
      (thing ?thing1)
      (thing.is_the_supplier_for.shipment
                              ?thing1 SH12345))
    (party.ships.shipment ?thing1 SH12345)))
```

Example: Measurements, quantities, and mass nouns

SH12345 consists of 1000 gallons of gasoline.

```
(exists (?gasoline1)
  (and
    (and
      (gasoline ?gasoline1)
      (quantity.is_the_volume_of.thing
       (Qvalue 1000 "gallon") ?gasoline1))
    (shipment.consists_of.thing SH12345 ?gasoline1)))
```

Example: Deontic rules

Every shipment must be registered.

```
(obligation (that
  (forall (?shipment1)
    (if
      (shipment ?shipment1)
      (thing.is_registered ?shipment1)))))
```

Example: Nominalized propositions

NIST prevents the situation where Ed is located in Seattle.

```
(forall (?situation1)
  (if
    (and
      (situation ?situation1)
      (thing.hasTheme.thing ?situation1
        (that
          (person.is_located_in.thing Ed Seattle)
        )))
    (person.prevents.situation NIST ?situation1)
  ))
```

Summary of interesting features

- n-ary verbs
  - Compatible with Davidsonian events
- Boolean connectives
- Quantifiers
- Properties
- Quantities and units of measurements
- Nominalized propositions
- Modals
- Collections

Thank you

https://sourceforge.net/projects/nistreconst/files/?source=navbar