RECON – A Controlled English for Business Rules

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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

Solution: Compile → logic language
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- Solution: RECON language $\xrightarrow{\text{compile}}$ logic language IKL
Example: RECON $\xrightarrow{\text{compile}}$ IKL

RECON Every person who attends RuleML is located in Seattle.
Example: RECON $\xrightarrow{\text{compile}}$ IKL

RECON  Every person who attends RuleML is located in Seattle.

IKL  $(\forall (\text{person}1) \left( \text{if} \left( \text{and} \left( \text{person} \ ?\text{person}1 \right) \left( \text{person}.\text{attends}.\text{conference} \ ?\text{person}1 \ \text{RuleML} \right) \right) \left( \text{person}.\text{is}.\text{located}.\text{in}.\text{thing} \ ?\text{person}1 \ \text{Seattle} \right) \right))$
The big picture

Input
- Dictionary
- Vocabulary
- Axioms

RECON Tool
- Main Components
  - Vocabulary Manager
  - Parser
  - Logic Generator

Output
- IKL file
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
- 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
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
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
Bride of Neptune is a registered tanker.

\[
(\text{exists } (?\text{tanker1}) \\
\quad \text{(and} \\
\quad \quad \text{(and) } \\
\quad \quad \quad \text{(tanker } ?\text{tanker1}) \\
\quad \quad \quad \quad \text{(thing.is.registered } ?\text{tanker1}) \\
\quad \quad \quad \quad \quad \quad \text{(=} \text{Bride.of.Neptune } ?\text{tanker1})))
\]
Example: Quantification

Every supplier ships some shipment.

\[
(\text{forall } (?\text{supplier1}) \\
(\text{if } \\
(\text{supplier } ?\text{supplier1}) \\
(\text{exists } (?\text{shipment2}) \\
(\text{and } \\
(\text{shipment } ?\text{shipment2}) \\
(\text{party.ships.shipment } ?\text{supplier1 } ?\text{shipment2}) \\
)))))
\]
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.

\[
(\text{forall}(\text{?shipment1})
(\text{if}
(\text{and}
(\text{shipment}\text{ ?shipment1})
(\text{shipment}\.\text{is}\.\text{shipped}\.\text{via}\text{.vessel}\n\text{?shipment1 B}\text{ride}\text{.of}\text{.Neptune}}))
(\text{thing}\.\text{is}\.\text{registered}\text{ ?shipment1})))
\]
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.

\[
\text{(obligation (that (forall (?shipment1) (if (shipment ?shipment1) (thing.is.registered ?shipment1)))))}
\]
Example: Nominalized propositions

NIST prevents the situation where Ed is located in Seattle.

\[
(\text{forall } (?\text{situation1})
\quad (\text{if}
\quad \quad (\text{and}
\quad \quad \quad (\text{situation } ?\text{situation1})
\quad \quad \quad (\text{thing}.\text{hasTheme}.\text{thing} ?\text{situation1}
\quad \quad \quad \quad (\text{that}
\quad \quad \quad \quad \quad (\text{person}.\text{is located in}.\text{thing} \text{Ed Seattle})
\quad \quad \quad \quad )))
\quad \quad (\text{person}.\text{prevents}.\text{situation} \text{NIST } ?\text{situation1})
\quad ))
\]
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