

Title: Canadian Submission for proposed Revision of ISO 24707 (Common Logic)
Source: Canada
Status: National Body Position
Action: For distribution to WG2 for Krakow 2012
Date: 9 October 2012

Background

Common Logic is a logic framework intended for information exchange and transmission. The framework allows for a variety of different syntactic forms, called dialects, all expressible within a common abstract syntax and all sharing a single semantics.

As a result of different implementations of systems using Common Logic, a number of syntactic and semantic issues have emerged.

Recommendation for Second Edition

Given the scope of the changes that are being proposed, we recommend that the development of a Second Edition of ISO 24707 (Common Logic) be initiated.

The proposal for the Second Edition of ISO 24707 (Common Logic) encompasses both syntactic and semantic issues, which are summarized below; they are discussed in more detail in the attached documents.

Description of Issues

Syntactic Issues

Syntactic issues within the scope of the revision include:

- ⤴ Fixing the list of syntactic errors that have already been identified in Defect Report ([Issue 1 in Annex A](#))
- ⤴ Correction and completion of the XML syntax in 24707 Annex C ([Issue 2 in Annex A](#))
- ⤴ More general approach to annotation of cl-texts ([Issue 7 in Annex A](#))

Semantic Issues

Semantic Issues which are modifications of the existing standard:

- ⤴ Clarification of conformance conditions ([Issue 3 in Annex A](#))
- ⤴ Modification of semantics to allow the existence of definitional extensions in CL ([Issue 5 in Annex A](#))
- ⤴ Semantics of cl-module ([Issue 6 in Annex A](#))
- ⤴ Questions about segregated dialects and interoperability ([Issue 8 in Annex A](#))

Semantic issues which constitute new features for the Second Edition:

- ⤴ Namespacing ([Issue 4 in Annex A](#))
- ⤴ Numerical quantifiers ([Issue 9 in Annex](#))

New Annexes

New Informative Annexes are also proposed for the Second Edition:

- ⤴ Informative Annex that includes the axiomatization of useful 'structural' axioms eg arity of relations, allDifferent, etc.. which are ontologically neutral ([Issue 10 in Annex A](#))
- ⤴ Informative Annex on CL proof theory ([Issue 11 in Annex A](#))

Additional improvements

The following issues are considered to be Optional for the Second Edition:

- ⤴ Additional concrete syntax to include in Annexes (e.g. Infix) ([Issue 12 in Annex A](#))
- ⤴ Additional logical connectives added to the abstract syntax ([Issue 13 in Annex A](#))
- ⤴ Informative Annex that provides a reserved vocabulary for structural descriptive names (in the sense of Tarski) ([Issue 14 in Annex A](#))
- ⤴ Query language for Common Logic ([Issue 15 in Annex A](#))

Annex A: ISO/IEC 24707 Issue Reports

Issue 1: Syntax errors identified in Defect Report

Project #:
Standard #: ISO/IEC 24707 Edition 2
WG2 doc #: WG2 N
Submitter/Source: Canada
Date Submitted: 2012-10-04
Severity: Major Technical
Status: Open
Date Last Updated:
Updated by:

Problem Description:

A list of errors in the syntax specified by ISO 2407 have been identified in a Defect Report (WG2 N1703)

Proposal:

Fix the list of syntactic errors that have already been identified in Defect Report

References:

ISO/IEC 24707:2007 Common Logic (Edition 1)
WG2 N1703 ISO/IEC 24707 Defects Report

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution
Draft Resolution Date
Draft Resolution Source
Status of implementation
Final Resolution
Final Resolution Date
Final Resolution Source

Issue 2: Correction and completion of the XML syntax in Annex C

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Major Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Several errors have been identified in the specification of the XML surface syntax in Annex C. Some features that should have been included are missing in the current edition of the standard.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 3: Clarification of Conformance Conditions

Project #:
Standard #: 24707 Edition 2
WG2 doc #: WG2 N
Submitter/Source: Canada
Date Submitted: 2012-10-04
Severity: Major Technical
Status: Open
Date Last Updated:
Updated by:

Problem Description:

The current specification of conformance conditions has ambiguity in some cases. In particular, it is not clear whether syntactic conformance of a dialect in the current standard guarantees interoperability.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution
Draft Resolution Date
Draft Resolution Source
Status of implementation
Final Resolution
Final Resolution Date
Final Resolution Source

Issue 4: Namespacing

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Major Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

The current version of the standard does not support namespacing in cl-text or cl-module.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 5: Definitional Extensions

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Major Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

The semantics specified in the current version cannot guarantee that definitional extensions are conservative extensions (as is the case with first-order, infinitary, and second-order logics).

In logic, a definitional extension of a theory is kind of syntactic sugar that can be eliminated.

Problem: in CLIF, this is not the case. Definitional extensions are generally not even conservative. Given a CLIF theory T , the addition of sentences like

$(\text{forall } (x) (\text{iff } (p \ x) \ \text{phi}))$

$(\text{forall } (x) (= (f \ x) \ t))$

(where phi is a formula and t a term, both possibly involving x), leads to new theorems in the language of T , namely

$(\text{exists } (p) (\text{forall } (x) (\text{iff } (p \ x) \ \text{phi})))$

$(\text{exists } (f) (\text{forall } (x) (= (f \ x) \ t)))$

Of course, some T 's might already entail these sentences, but generally, T does not.

Proposal:

Allow the use of non-discourse names in CLIF. If we use, say, all identifiers starting with @ for non-discourse names, then we can write:

(forall (x) (iff (@p x) phi))

(forall (x) (= (@f x) t))

and get conservative extensions of T.

References:**Discussion/Notes:****Committee Proposed Resolution:**

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 6: Semantics of cl-module

Project #:
Standard #: 24707 Edition 2
WG2 doc #: WG2 N
Submitter/Source: Canada
Date Submitted: 2012-10-04
Severity: Major Technical
Status: Open
Date Last Updated:
Updated by:

Problem Description:

Several counterexamples with the use of cl-module have been identified in the current version of the standard. The semantics of cl-module needs to be extended to address these counterexamples.

This raises questions about the use of functional expressions within modules (or embedded segregated texts) that we haven't discussed yet. Consider:

```
(= (bestFriend calvin) hobbes)
(= (favoriteFood hobbes) tuna)
(RealEntity calvin)
(RealEntity tuna)
(not (RealEntity hobbes))
(cl:module RealEntity
  (Delicious (favoriteFood (bestFriend calvin))))
)
```

Note that within the module Hobbes does not exist, because he is an imaginary friend of Calvin and not a real entity. Thus, (bestFriend calvin) does not refer to anything in the local domain. However, the reference of (bestFriend calvin) is defined (it is an element of the wider universe of discourse) and since "favoriteFood" is a total function on the wider universe of discourse "(favoriteFood (bestFriend calvin))" is defined and refers to something in the local domain.

Is this ontology satisfiable?

It seems to me that the module (and thus the whole ontology) should be false, since the term (bestFriend calvin) does not refer to anything in the local universe of the module. We could

achieve that goal by adding a condition to the semantics of modules that requires all terms that occur in a module to denote something in the local universe, even if they occur only as part of a complex term. In other words, according to this proposal the module

```
(cl:module RealEntity
  (Delicious (favoriteFood (bestFriend calvin)))
)
```

would logically entail

```
(and
  (RealEntity (favoriteFood (bestFriend calvin)))
  (RealEntity (bestFriend calvin))
  (RealEntity calvin)
)
```

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 7: General Annotation of cl-texts

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Optional

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Modifications to the syntax of cl-comment have been addressed in the Defect Report. Additional features for a more general approach to the annotation of cl-texts is also required.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

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Final Resolution Source

Issue 8: Segregated Dialects and Interoperability

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Major Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Several counterexamples indicate difficulties with the interoperability of segregated and unsegregated dialects.

Let's suppose that System A uses classical FOL, and system B uses full CL semantics. Let's assume that they interact just by passing messages between them, which each one interprets in terms of its own ontology.

To guarantee safe interoperability, let's assume that the messages are expressed in terms that are defined by a shared common ontology, which does not use any features of the more expressive CL semantics.

Issues to consider:

1. How do you define that common ontology?
2. Since System A uses only classical FOL, the ontology couldn't use any features of full CL. Therefore, the equivalent ontology in System B would have to use a segregated dialect to express it.
3. But System B also uses theories expressed in full CL semantics. What happens when those theories are used to reason about messages that came from System A?
4. If any quantified variable refers to anything in those messages, it could be used in functional or relational position in some sentences of the full CL dialect.
5. Any such use would raise all the issues about interactions with that infinity of models for full CL semantics. In fact, they are exactly the same issues that arise when importing modules from a segregated dialect into a full CL dialect.

If we want to support interoperability, it seems that we cannot avoid the questions about importing sentences from segregated dialects into environments with full CL semantics.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 9: Numerical Quantifiers

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Major Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Extend the syntax and semantics of CL to incorporate numerical quantifiers.

Adding numeric quantification that supports sentences like

>> (exists (n Number) (exists n (y) (P a y)))

is not a trivial task. The problem is that -- at least on the face of it -- "n" in the formula above is just a name which is used in a quantification restricted to "Number". This seems to work in the same way as the first quantifier in the example below is restricted to dogs.

>> (exists (x Dog) (exists (y) (P x y)))

To make this work one seemingly only needs to fix the interpretation of "Number" to the positive integers, and then the normal semantics for restricted quantification takes care of the rest.

Unfortunately, it is not as easy. Consider the following

```
(module Dog (
  (exists (n Number)(forall (x) (exists n (y) (DescendentOf x y)))
)
```

This is supposed to express that every dog is only a descendent of a finite number of dogs. (By the way, this is an example of non-first-order expressivity these quantifiers provide.) However, assuming that Number and Dog are disjoint, there are no numbers in the local domain of the module. Thus, the first quantifier cannot be bound to anything and thus module is false.

By the way, giving the semantic of modules (and still assuming that no numbers are dogs)

```
(module Dog (
  (forall (x) (exists 2 (y) (ChildOf x y)))
```

```

)
is satisfiable, but
(module Dog (
  (exists (n Number)
    (and
      (= 2 n)
      (forall (x) (exists n (y) (ChildOf x y)))
    )))

```

is not satisfiable, because '2' occurs in argument position but does not refer to anything in the local domain of quantification.

I see two possibilities to make this work. Either to enforce that the natural numbers are always in the domain of quantification or to introduce sortal quantification. The first seems to undermine the whole point of modules. The second would change CL significantly, since it does not support sortal quantifiers until now.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 10: Structural Axioms

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Minor Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Recommendation for an Informative Annex that includes the axiomatization of useful 'structural' axioms (eg arity of relations, allDifferent, etc.) which are ontologically neutral

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 11: Proof Theory

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Minor Technical

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Recommendation for an Informative Annex that specifies a proof theory for CL.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

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Status of implementation

Final Resolution

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Final Resolution Source

Issue 12: Additional Concrete Syntax

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Optional

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Extend the current version of the standard with additional concrete syntax (such as infix) to be included in an Annex.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 13: Additional Connectives

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Optional

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Extend the abstract syntax in the current version of the standard with additional logical connectives.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 14: Structural Descriptive Names

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Optional

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Recommendation to include an Informative Annex that provides a reserved vocabulary for structural descriptive names (in the sense of Tarski)

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

Final Resolution Date

Final Resolution Source

Issue 15: Query Language

Project #:

Standard #: 24707 Edition 2

WG2 doc #: WG2 N

Submitter/Source: Canada

Date Submitted: 2012-10-04

Severity: Optional

Status: Open

Date Last Updated:

Updated by:

Problem Description:

Extend the current version of the standard with a query language.

Proposal:

References:

Discussion/Notes:

Committee Proposed Resolution:

Draft Resolution

Draft Resolution Date

Draft Resolution Source

Status of implementation

Final Resolution

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Final Resolution Source