Common Logic

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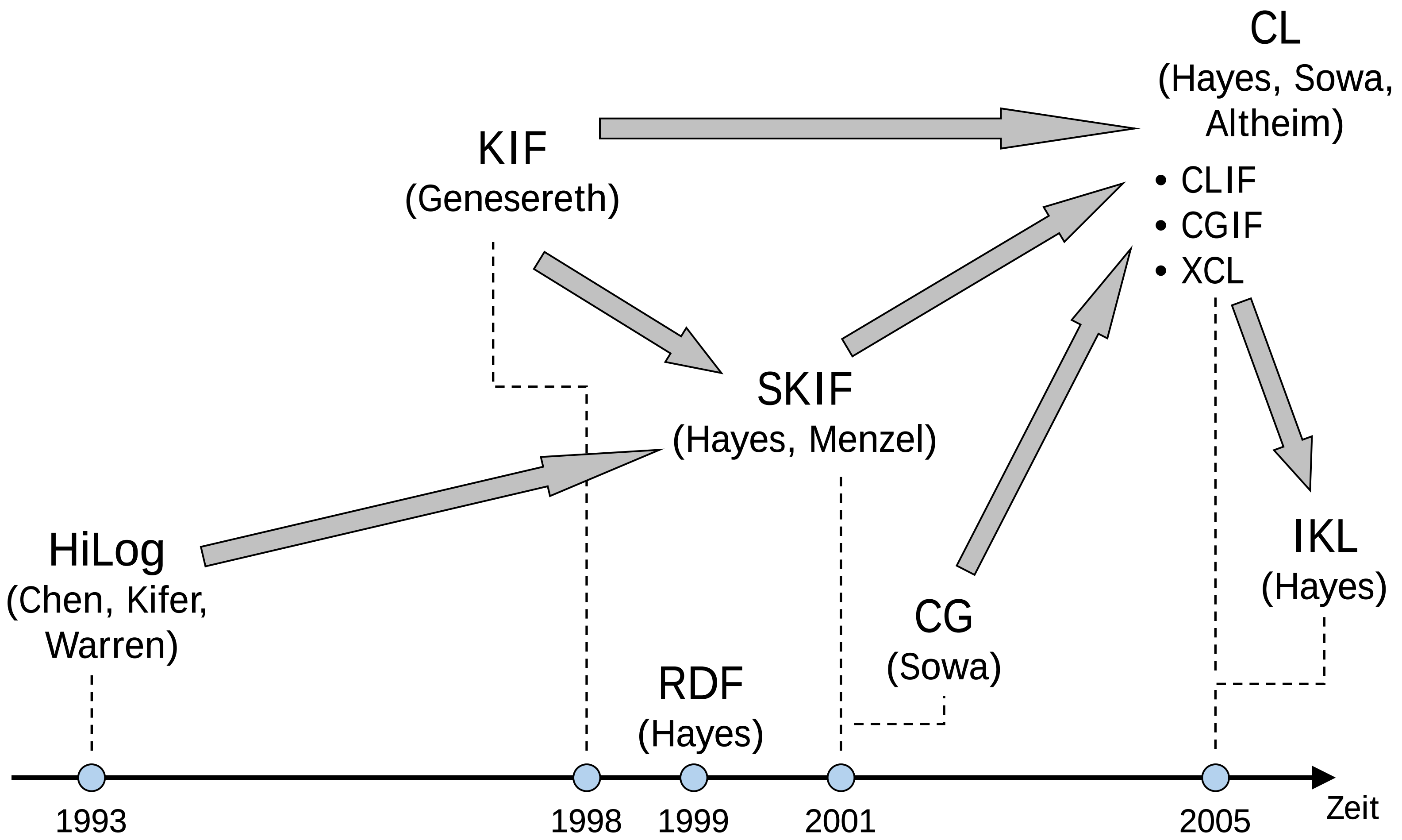
Contents

Background


CL
(Hayes, Sowa, Altheim)
• CLIF
• CGIF
• XCL
KIF
(Genesereth)
SKIF
(Hayes, Menzel)
HiLog
(Chen, Kifer, Warren)
CG
(Sowa)
IKL
(Hayes)
RDF
(Hayes)
1993
1998
1999
2001
2005
Zeit

The Common Logic dialects

- Common Logic is a family of languages
- Common Logic dialects:
  - Common Logic abstract syntax
  - Common Logic Interchange Format (CLIF)
  - Conceptual Graph Interchange Format (CGIF)
  - Extended Common Logic Markup Language (XCL)
- All have the same semantic

CL abstract syntax categories

- (text, phrase, comment, module, importation, irregular sentence)
- sentence
- quantified sentence
- boolean sentence
- atom
- term
- functional term
- term sequence
- name

CL abstract syntax categories

- quantified sentence:
  - quantification over a finite sequence of names or sequence names
- boolean sentence:
  - arity of conjunction and disjunction is arbitrary
  - empty conjunction is the „true“ element
  - empty disjunction is the „false“ element
- name:
  - no distinction between relation names, function names and individual names
- sequence name:
  - stands for an arbitrary sequence of arguments

CL semantics

- **vocabulary** is a set of names and sequence names
- **interpretation** I of a vocabulary V:
  - a set UR_I with a distinguished nonempty subset UD_I
  - and four mappings
    - rel_I : $UR_I \rightarrow Pow(UD_I^*)$
    - fun_I : $UR_I \rightarrow Pow(UD_I^* \times UD_I)$
    - int_I : from names in V $\rightarrow UR_I$
    - seq_I : from sequence names in V $\rightarrow UD_I^*$

  - UR = universe of reference, UD = universe of discourse
  - $int_I(x) \in UD_I$ if and only if x is a discourse name

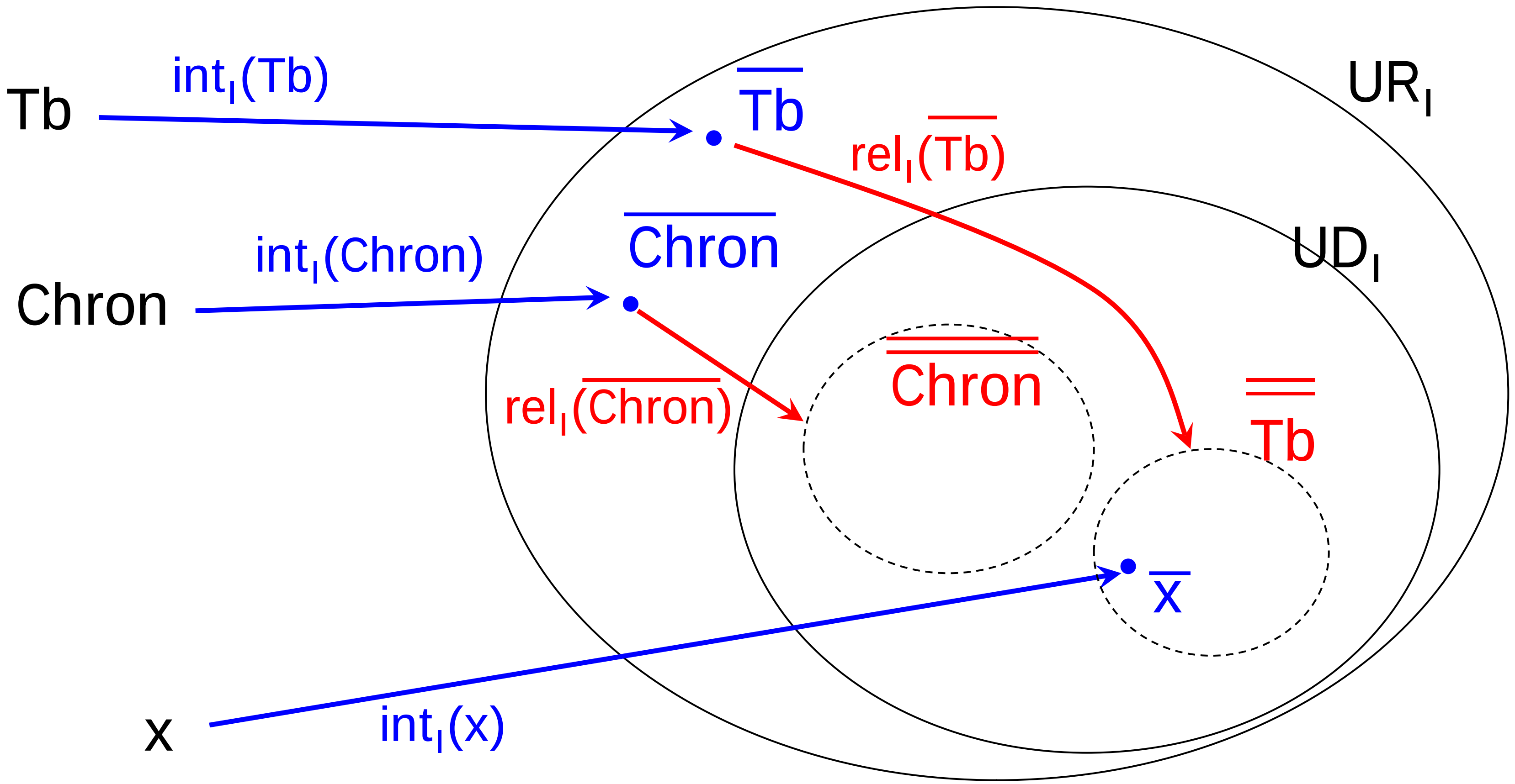
Examples (in CLIF syntax)

- (not (exists (x) (and (Tb x) (Chron x))))
  - I((Tb x)) true if I(x) $\in$ rel_I(I(Tb))
  - I((Tb x)) true if int_I(x) $\in$ rel_I(int_I(Tb))

  - I((Chron x)) true if I(x) $\in$ rel_I(I(Chron))
  - I((Chron x)) true if int_I(x) $\in$ rel_I(int_I(Chron))

Examples

(not (exists (x) (and (Tb x) (Chron x))))



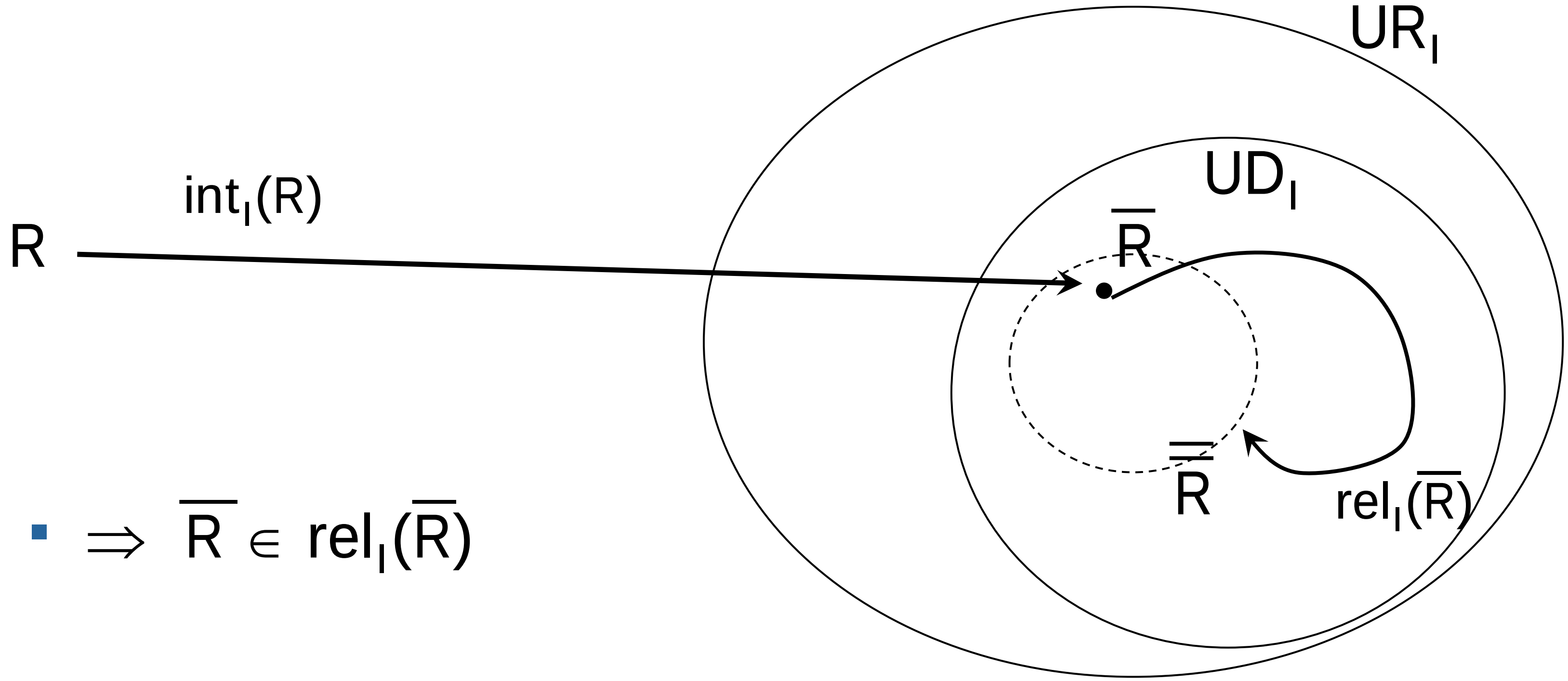
Examples

- (forall (x) (if (Chron x) (and (exists (u) (lb u x)) (exists (v) (rb v x)))))
  - I((lb u x)) true if (I(u),I(x)) $\in$ rel_I(I(lb))
  - I((lb u x)) true if (int_I(u),int_I(x)) $\in$ rel_I(int_I(lb))

- (sum a b)
  - I((sum a b)) = the x such that (I(a),I(b),x) $\in$ fun_I(I(sum))
  - I((sum a b)) = the x such that (int_I(a),int_I(b),x) $\in$ fun_I(int_I(sum))

Uncommon Aspects

- self-application: (R R)
  - I((R R)) true if $I(R) \in rel_I(I(R))$
  - I((R R)) true if $int_I(R) \in rel_I(int_I(R))$



  - $\Rightarrow \overline{R} \in rel_I(\overline{R})$

Uncommon Aspects (self-application)

- Can you construct the Russell paradox ?
- Some considerations:
  - $\forall x\ C(x) \leftrightarrow P(x) \wedge Q(x)$
    - Interpretation:
      - $I(x) = int_I(x)$, let be $int_I(x) = \overline{x}$
      - $I(C) = rel_I(int_I(C))$, let be $rel_I(int_I(C)) = \overline{\overline{C}}$,

        $I(P) = \overline{\overline{P}}$ and $I(Q) = \overline{\overline{Q}}$
      - $\overline{x} \in \overline{\overline{C}} \leftrightarrow \overline{x} \in \overline{\overline{P}} \wedge x \in \overline{\overline{Q}} \leftrightarrow \overline{x} \in \overline{\overline{P}} \cap \overline{\overline{Q}}$

        and so: $\overline{\overline{C}} = \overline{\overline{P}} \cap \overline{\overline{Q}}$

Uncommon Aspects (self-application)

- $\forall X\ D(X) \leftrightarrow X(X)$
  - Interpretation:
    - like before
    - Is this the correct meaning ?
      $\forall \overline{x}\ \forall \overline{y}\ \ \overline{y} \in rel_I(\overline{D}) \leftrightarrow \overline{y} \in rel_I(\overline{X}) \wedge \overline{x} = \overline{y}$

Uncommon Aspects

- sequence names:
  - universal quantifier binding a sequence name has the same semantic import as the infinite conjunction of all the expressions obtained by replacing the sequence name by a finite sequence of names, all bound by the universal quantification
  - Example: (in CLIF syntax)

    `(forall (...x) (foo ...x))`

    has the same meaning as an infinite conjunction of this form

    ```
    (and (foo)
    (forall (x1) (foo x1))
    (forall (x1 x2) (foo x1 x2))
    (forall (x1 x2 x3) (foo x1 x2 x3))
    ... )
    ```