Breaking Down DOLCE

Composing & Decomposing Ontologies

Carmen Chui

Semantic Technologies Lab, University of Toronto

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Agenda

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What is DOLCE?

DOLCE: Descriptive Ontology for Linguistic and Cognitive Engineering

A *foundational ontology* developed by the Laboratory for Applied Ontology in Trento, Italy.

- Part of the WonderWeb Foundational Ontologies Library
- Captures ontological categories that underlie natural language and common sense in *first-order logic*
- Intended to clarify any implicit assumptions between existing ontologies or linguistic resources such as WordNet

DOLCE's Taxonomy

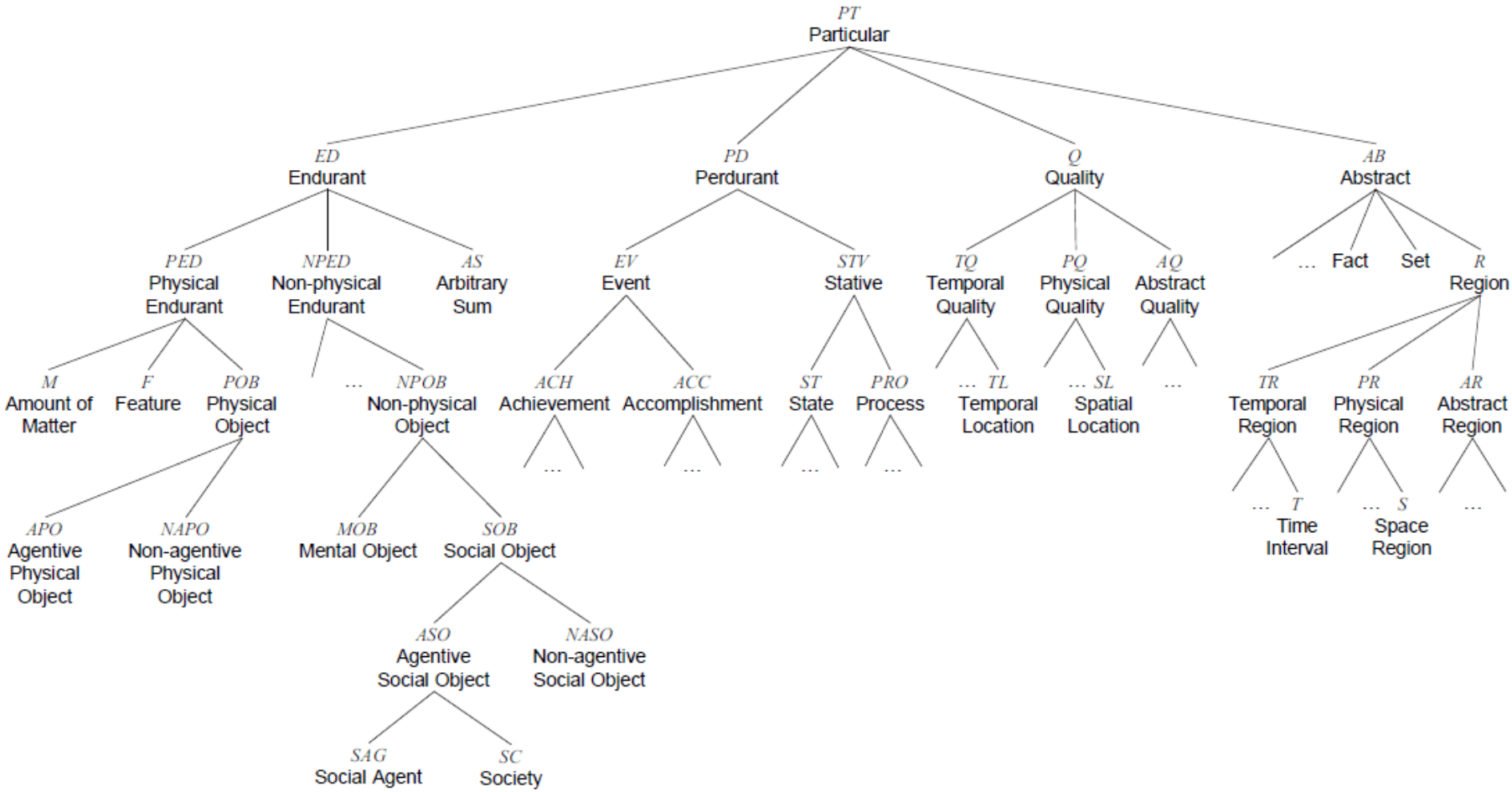

Figure: The DOLCE taxonomy (Figure 2 in [3]).

Objectives

Verifying & Modularizing DOLCE in COLORE

- Create a Common Logic-based version of DOLCE in the COmmon Logic Ontology Repository (COLORE)
  - .../colore/source/browse/trunk/ontologies/complex/dolce/
- Verify and map DOLCE into COLORE
- Identify any missing theories in COLORE needed for the mapping process
- Apply similar decomposition techniques found in [2] to determine whether it is possible to derive similar, if not the same, modules

Motivations

Taxonomies and Modularity

- What happens when we decompose DOLCE?
  - Will the *modules* be the same as the different categories found in the DOLCE taxonomy?
  - How would DOLCE modules be related to each other?
- What kind of role does the taxonomy play in ontology design?

Composition & Decomposition of Ontologies

- Are composition/mapping and decomposition/modularization inverses of each other?
- If we decompose an ontology into modules, and then take these modules compose an ontology, is this new ontology the same as what we started with?
- Can various decomposition and composition approaches be grouped together in terms of equivalence (same outputs)?

The Research Opportunity

DOLCE's Relationships with Existing Theories in COLORE

COLORE contains first-order theories that include the concepts described in DOLCE.

- What kind of relationships exist between these different representations of concepts (e.g., participation of activities, parthood)
- Are these representations equivalent? If so, how?

DOLCE-CORE

A Foundational Ontology: DOLCE-CORE

- DOLCE-CORE is introduced in [1] as a *revision* to DOLCE
- Consists of axioms found in theories that consist of notions like 'having a property', 'being in time', and 'changing through time' [1]:
  - Parthood and Temporary Parthood: Part $P(x, y)$, Overlap $O(x, y)$, Mereological Sum $SUM(z, x, y)$, Being Present $PRE(x, t)$, Coincidence $CC(x, y, t)$
  - Properties: Classification $CF(x, y, t)$, Inheritance $I(x, y)$, Location $L(x, y, t)$
  - Objects and Events: Participation $PC(x, y, t)$
- We are primarily interested in their axioms for *Temporary Parthood*
- We treat DOLCE-CORE as a *non-conservative extension* of DOLCE since it introduces new axioms

Current Framework of DOLCE Theories

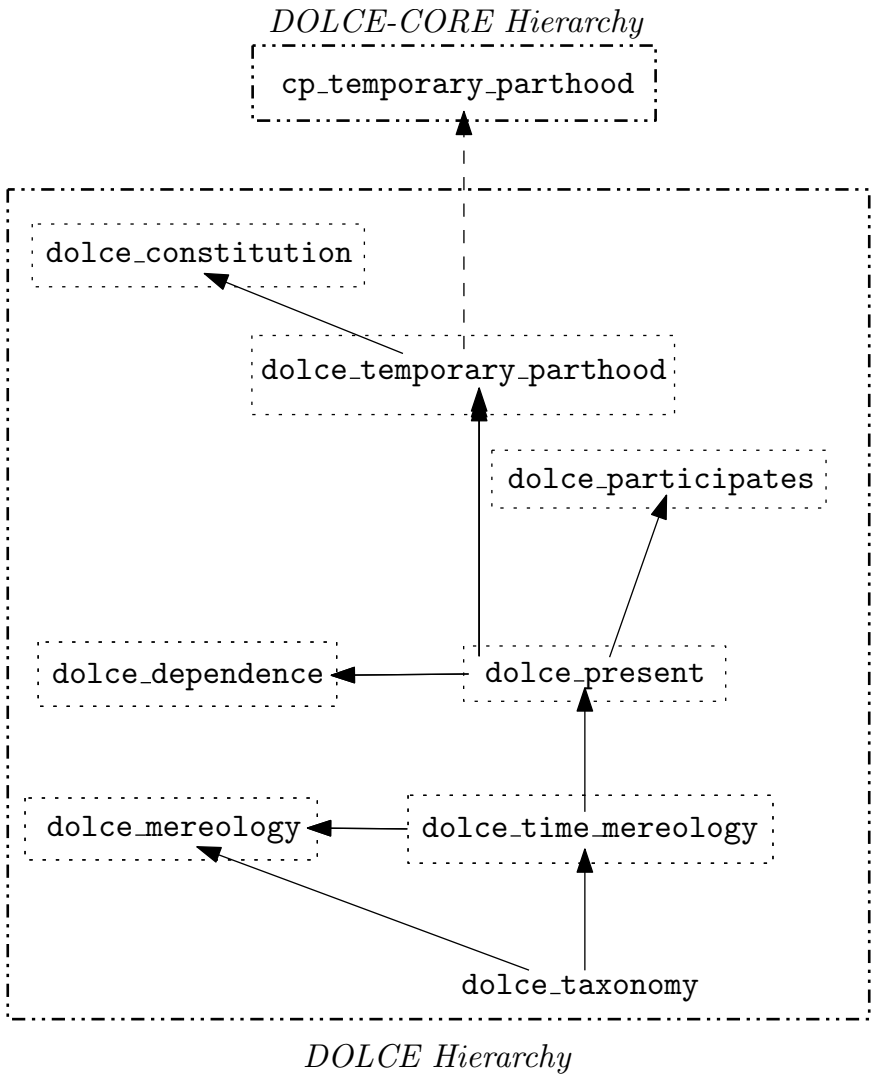

Figure: Relationships between DOLCE theories.

Preliminary Mapping of DOLCE into COLORE

Assumptions and Simplifications Made

- DOLCE's taxonomy is not axiomatically defined in the WonderWeb document, so we have provided our own subsumption and disjointness axioms to describe it
- We ignore all *modal logic* operators found in DOLCE axioms
- The relation $PRE(x, t)$ is assumed to be a primitive
  - Similar assumption made in [2]

Exclusion of Quality, and Temporal and Spatial Quales in DOLCE

These axioms are *complex* and involve many substitutions to get to the axioms' full form. Since we intend to verify these axioms and the Prover9 theorem prover is unable to parse this 'wild west' syntax, we will look into these axioms later.

The Need for A Time Interval Version of PSL

- When mapping DOLCE with PSL, we realized that DOLCE utilizes **time intervals** instead of time points
- PSL only describes object and activity occurrences with respect to time points
  - We needed to create a time interval version of PSL (named *Interval PSL Hierarchy*)
- We introduce this as a new hierarchy, `interval_psl`, in COLORE which contains:
  - A time interval version of PSL-CORE: `interval_psl_core`
  - A time interval version of moment: `interval_moment`
  - A time interval version of mandatory: `interval_mandatory`

Mapping DOLCE's Participation with PSL

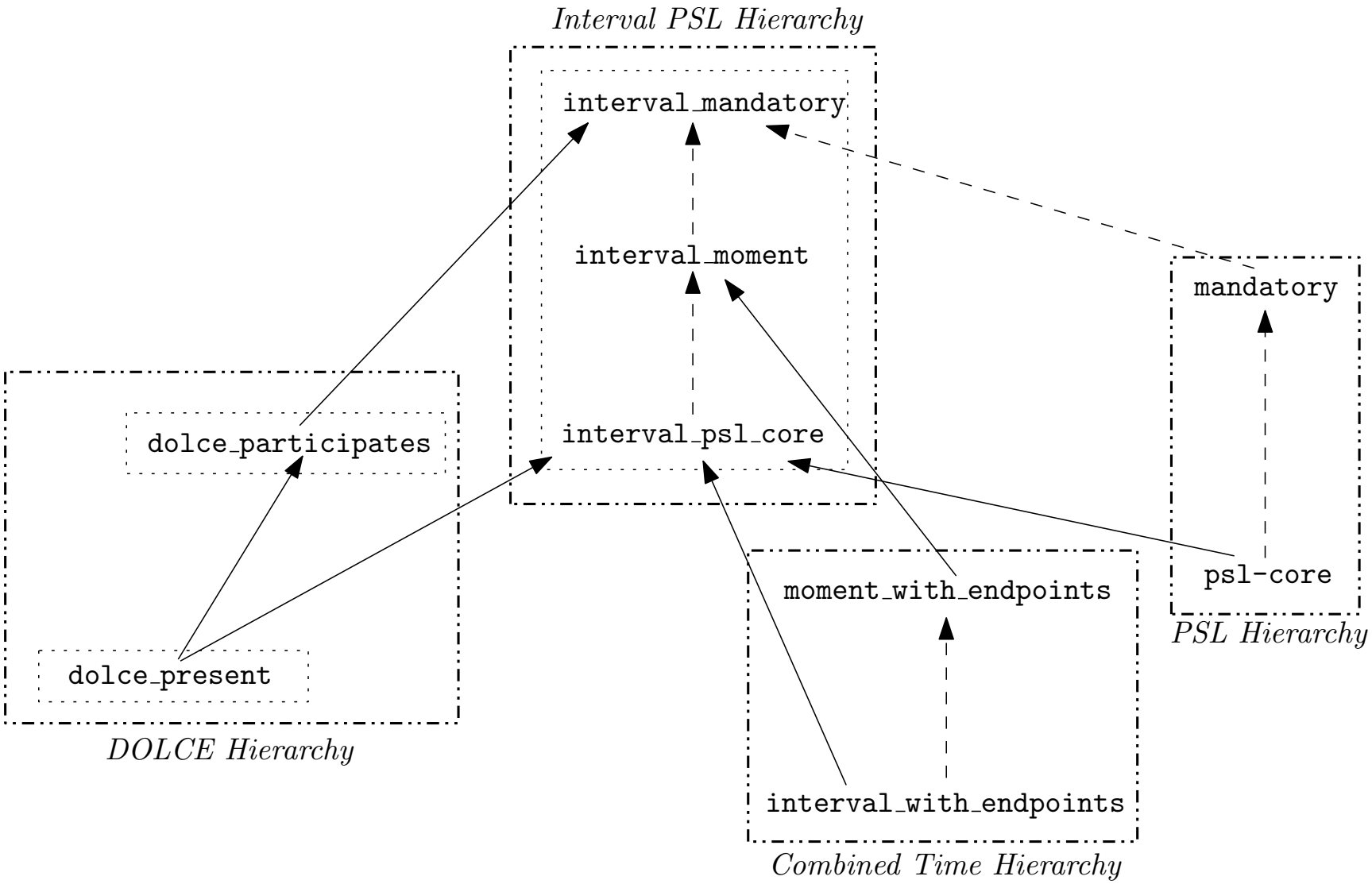

Figure: Relationship between DOLCE and PSL theories.

Tying It All Together

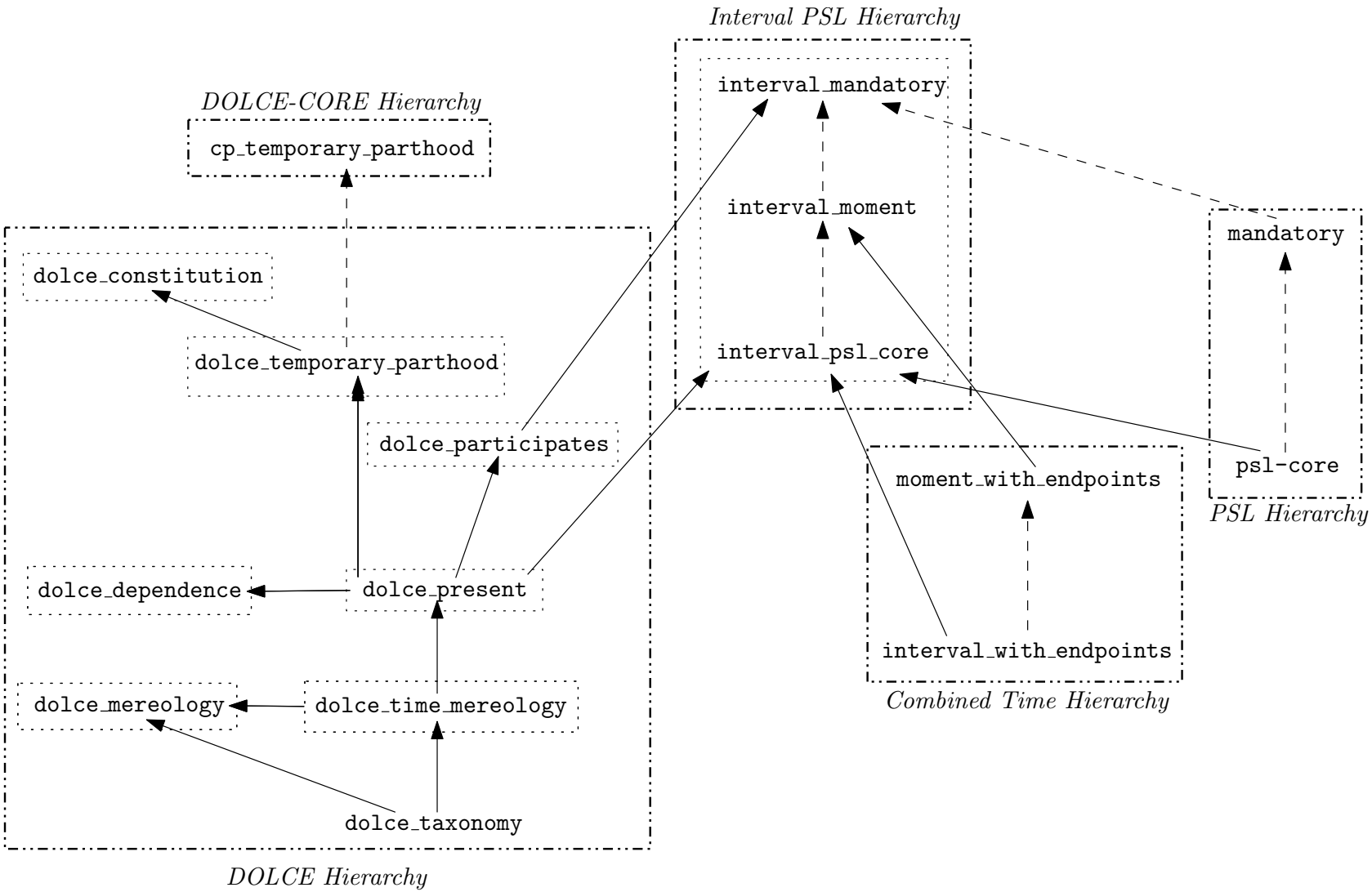

Figure: Relationship between CLIF files

Remaining & Future Work

- Continue verification of the axioms with Prover9 and modifying them where necessary
- Add DOLCE's axioms for Dependence and Quality into COLORE
- Identify any missing hierarchies and theories within COLORE during the mapping process
  - For example, the `mereological_geometry` hierarchy has been added to COLORE
- Identify additional COLORE theories that can be mapped to the remaining DOLCE theories
- Determine any implicit relationships between DOLCE, PSL, and other COLORE theories and make them explicit by writing out the axioms

References & Additional Links

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