

Conceptual Topology Language (CTL): A Categorical Framework for Semantic Computation

A minimal semantic calculus based on category-theoretic structure, modeling logical operations (AND, OR, XOR, NOT, implication) over contextual frames (Z-frames), and enabling semantic evaluation via conceptual morphisms. This α -version demonstrates the construction of exponential objects, semantic XOR, and Z-dependent entailment classification (χ).

Logical Operations in Conceptual Topology

Following CTL Examples are simplified version. You need to clarify the Z frame as follows.

```
girl  $\Leftrightarrow$  woman | Human  $\wedge$  Femenity
```

Logical Symbol	CTL Example	Categorical Structure
\top (true)	The concept of truth	Terminal object 1
\perp (false)	A null concept	Initial object 0 or Zero morphism
$\neg p$ (not p)	$\sigma(Z).Not(f)$	Zero morphism (rupture)
$\neg\neg p$	Equalizer($\sigma\circ\sigma, id$)	Equalizer (closure of negation)
$p \wedge q$	$girl \wedge dog \cong mammal$	Pullback (common intersection)
$p \vee q$	$dog \vee cat \cong pet$	Coproduct (union of categories)
$p \vee\vee q$	$man \vee woman \cong genderness$	$p \vee\vee q := (p \vee q) \ominus (p \wedge q)$
$p \Rightarrow q$	$dog \Rightarrow mammal$	Exponential object ($Hom(p, q)$)
$p \Leftrightarrow q$	$girl \Leftrightarrow woman$	Isomorphism (bidirectional morphism)
$p = q$	$girl = girl$	Identi y Morphism (conceptual identity)
$p \cong q$	$girl = woman$	Isomorphism (conceptual identity)
$\exists x. P(x)$	$\exists dog. dog \in pet$	Co-limit (existential quantification)
$\forall x. P(x)$	$\forall dog. dog \in mammal$	Limit (universal quantification)
$p \oplus q$	$man \oplus young = guy$	Kan Extension or $\sigma(Z). \oplus(A_{n-1}, B_{n-1}, Z)$
$p \ominus q$	$guy \ominus young = man$	$\sigma(X). \ominus(f, A_{n-1})$

XOR

Example1:

```
using z-space Female
p ⊔ q := (p ∨ q) ⊖ (p ∧ q)
girl ⊔ woman
= (girl ∨ woman) ⊖ (girl ∧ woman)
= age-attribute|Attribute
```

Diagram:



Example 2:

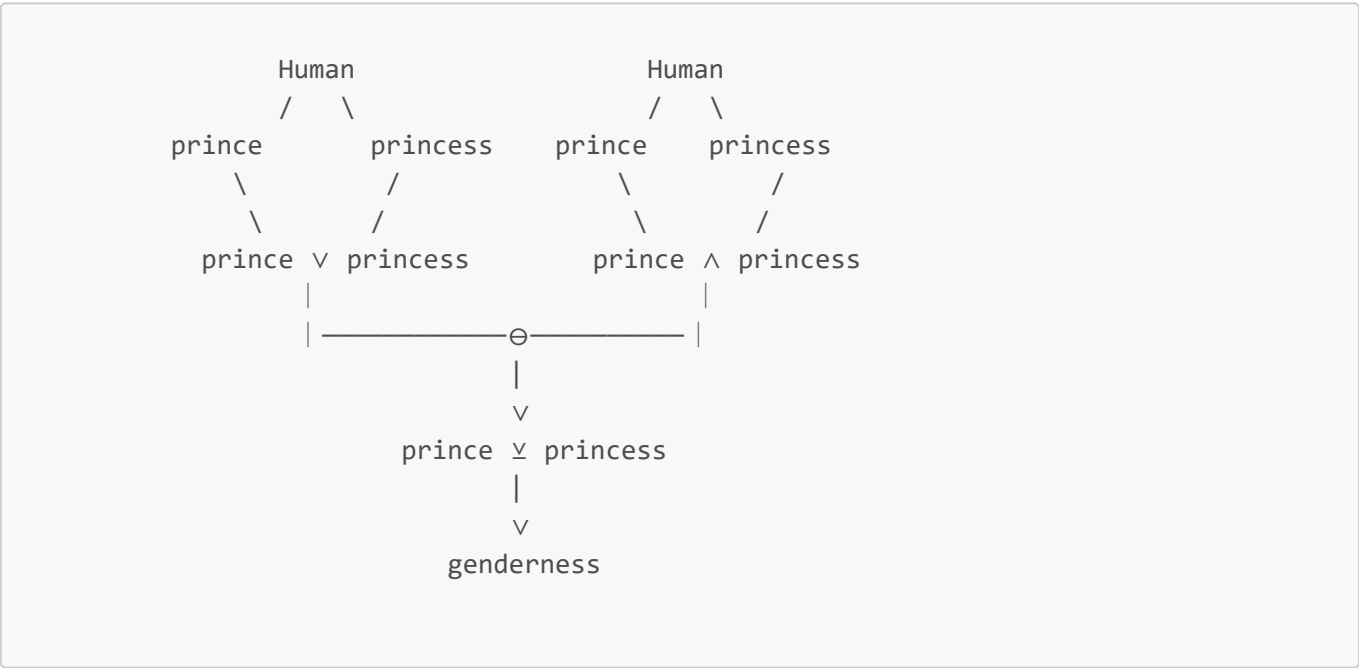
```
prince ∨ princess = genderness|Attribute

Let:
  A = prince
  B = princess
  Z = Human
  f = A ∨ B | Z    // Coproduct
  g = A ∧ B | Z    // Pullback

Then:
  h = f ∨ g | Z    // Difference morphism: genderness

Therefore:
  genderness|Attribute = (prince ∨ princess | Human)
```

Diagram:



Double Negation As XOR

Xor can express double negation. This simplifies morphic flow. And this formulation $n \vee n \vee x$ reveals underlying semantic structure of language.

```
not unkind
= n ∨ n ∨ x
= x
where:
n: not, un-
x: kind
```

```
n ∨ n ∨ x corresponds to
  not un kind
    n    n  x
```

```
楽しくないわけじゃない
  x      n      n
→ x ∨ n ∨ n = x
```

Commutativity and Associativity ensures the interchangeability of the calculation.

Here we hypothesize () signifies the semantic cohesion, thus *not unhappy* does not fully recover to *happy*. (Semantic equality still holds.)

```
not unhappy ≠ happy
n ∨ (n ∨ x)
```

```
I didn't say I am not happy
  n              n    x
```

The formalization will be as follows.

```
// XOR-based semantic negation
∀x.  n ∨ n ∨ x = x           // strict reversible case
     n ∨ (n ∨ x) ≐ x        // cohesive partial case
```

⊕ in Diagram

using Z-frame Human
 prince = (king ⊕ man) ⊕ young | Attribute

Let:

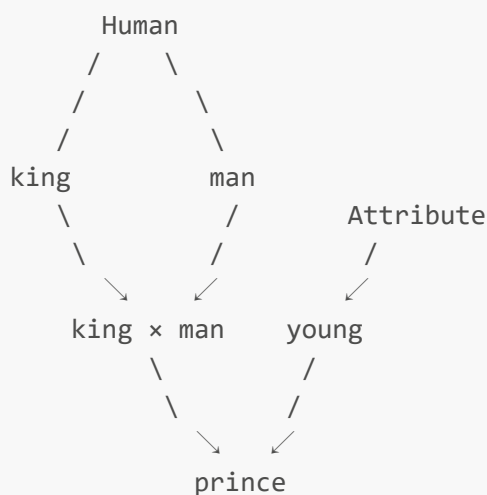
Z = Human
 A = king
 B = man
 C = young

Then:

$P_1 = A \oplus B \mid Z$
 $P_2 = P_1 \oplus C \mid Z$

Therefore:

prince := $P_2 \mid Z$



∧ vs ⊕

∧ strictly requires shared meaning and a shared Z-frame.

⊕ offers safe addition to the meaning and does not strictly require a shared Z-frame.

However, the presence of a common superordinate Z-frame (e.g. Mammal) is preferable for ensuring semantic continuity.

Definition of ⊕ Operator

$\sigma(Z). \oplus(A_{n-1}, B_{n-1}, Z) = D(C_{n-1} \mid CD) = M_C \mid CD$

Example:

$A_{n-1} := \text{girl} \rightarrow \text{she} \mid \text{Human}$

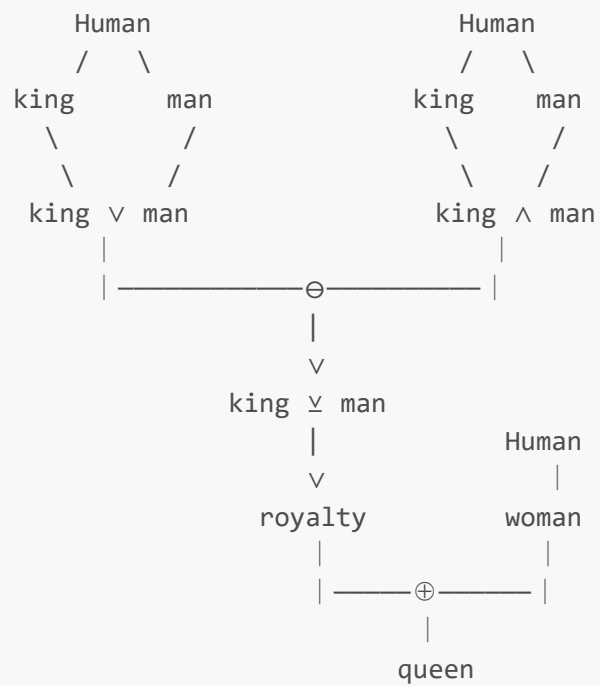
$B_{n-1} := \text{puppy} \rightarrow \text{dog} \mid \text{Canine}$

$\sigma(\text{Human}). \oplus(\text{girl} \rightarrow \text{she}, \text{puppy} \rightarrow \text{dog} \mid \text{Mammal}) \rightarrow M \mid Z(\text{girl} \rightarrow \text{she} \rightarrow \text{puppy} \rightarrow \text{dog} \mid \text{Mammal}) \mid \text{Mammal}$

king - man + woman = queen

$$\text{queen} = (\text{king} \sqcup \text{man}) \oplus \text{woman} \mid \text{Human}$$

Diagram:



Application

```

func exponential(a: Concept, b: Concept, z: Frame) -> ConceptualMorphism:
    """
    Construct exponential object  $B^A$  under Z-frame.
    Represents: 'if a then b' interpreted within context z.
    """
    return  $\sigma(z).>(a, b)$  // represents  $B^A$ 

func eval(f: Conceptual Morphism, a: Concept, z: Frame) -> Concept:
    return  $f \times a \mid z$ 

//if press then open → it opens
val1 = eval("press", "open", "door") → door → opened door | Door

//if press then open + you press → it opens
f = exponential("press", "open", "door")
val2 = eval(f, "you press") → open | Door // open → open | Door

// if means truth =  $\chi(val1, val2)$ 
//  $\chi$ : entailment classifier →  $\Omega$ 
if val1  $\Rightarrow$  val2:
    print("This is about door being opened")

```

simbols

Z : Intermediating variable (conceptual anchor; Z-frame)
 $|$: Frame separator (indicates morphism is mediated by Z-frame)
 \rightarrow : Morphic Flow
 $\rightarrow/$ Ruptured morphism
 F : Cross-category morphism (used in cross-category flow under shared Z-frame)
 $//$: Used to narrate meaning flow of morphic chains.
 \neg : Absence

 $M|Z$: Monoid of Conceptual Flow under Z-frame
 $R|Z := \{ \text{rupture}(f) \mid \text{rupture}(f, \sigma(f) \mid Z) \neq \emptyset \}$
 $e|Z$: Identity element of $M|Z$
 $D(A_{n-1} \mid Z)$: Morphic chain under Z frame

 σ : Conceptual Shifting Morphism
 $>>$: Generalization relation ($A >> X \equiv A \sqsubseteq X$)
 $<<$: Specialization relation ($X >> A \equiv X \sqsubseteq A$)
 $\text{rupture}(f, \sigma(f) \mid Z) \neq \emptyset$: Indicates conceptual rupture
 η : Quasi-Natural Transformation: Contextual alignment between morphic chains.

 \oplus : Conceptual morphism set addition in σ or morphic merger such as:
 $(k_2 \circ k_1) \oplus (q_2 \circ q_1) = \text{human} \rightarrow \text{royalty} \mid Z'$
 \ominus : Conceptual morphism set subtraction
Removes specified morphisms from a morphic chain or set.

Notations

Concept / Word (lexeme):
- Lower case (e.g., puppy, dog, girl, she)

Z Frame (conceptual anchor):
- Upper case (e.g., Mammal, Human, Agency, Domesticated, Royalty)

Type variables (A, B, X, Y, Z in formal definitions):
- Follow standard formal notation (uppercase)

Example:
puppy \rightarrow dog $|$ Mammal
 $A \rightarrow B \mid Z$

Morphism: f, g, h
Functor: F

Simplified Form of Identity Morphism:

1. $f: X \rightarrow X \mid X$ (Category-theoretic identity)
In simplified form: X
or more explicitly: id_X
2. $f: X \rightarrow X \mid Z$ (Mediated identity with conceptual flow)
In simplified form: $X \mid Z$

σ Operator

$\sigma(X). \text{Not}(x)\{ A \rightarrow B \mid Z \}$	\rightarrow	Rupture under Z frame
$\sigma(X). \text{so_much}(x)\{ A \rightarrow B \mid Z \}$	\rightarrow	Preservation & amplification under Z frame
$\sigma(X). \gg(x, y)$ function form	\rightarrow	Conceptual Shifting x to y (Generalization) as function form
$\sigma(X). \ll(x, y)$ function form	\rightarrow	Downward Shifting x to y (Specialization) as function form
$\sigma(X). >(x, y)$	\rightarrow	Conceptual Shifting

Conceptual Morphism Set Operators

Addition (\oplus):

$\sigma(X). \oplus(f, A_{n-1} \mid Z): D(A_{n-1} \mid Z) \rightarrow D(B_{n-1} \mid Z) \mid Z$

$\sigma(X). \oplus(f_1, f_2) : A_{n-1} := \{f_1, f_2\}$

Subtraction (\ominus):

$\Theta: A_{n-1} \ominus \{f_i\}$

$\sigma(X). \ominus(f, A_{n-1} \mid Z): D(A_{n-1} \mid Z) \rightarrow D(B_{n-1} \mid Z) \mid Z$

- \oplus operator is σ_{safe} if Z alignment is preserved.
- \ominus operator is potentially σ_{unsafe} but can be σ_{safe} if resulting chain preserves the underlying morphic continuity Z .

σ Typing Hierarchy

$\sigma_{\text{safe}}: D(A_{n-1} \mid Z) \rightarrow D(B_{n-1} \mid Z) \mid Z$ (Preserves global coherence)

$\sigma_{\text{unsafe}}: D(A_{n-1} \mid Z) \rightarrow \{ \text{rupture}(f_1), \dots, \text{rupture}(f_n) \mid \neg Z \}$ (Global coherence lost)

Note: σ_{safe} behaves as Quasi-Natural Transformation.

σ_{unsafe} induces rupture, and cannot be captured globally.

This is version α 1.1.1

Conceptual Topos Named as 概念位相論 / Conceptual Topology

This theory, named 概念位相論 or Conceptual Topology, was proposed by **No Name Yet Exist**.

Meaning no longer escapes.

It circulates within the morphic fibration.

We, once again, govern the topology of meaning.

GitHub: <https://github.com/No-Name-Yet-Exist/Conceptual-Topology>

Note: <https://note.com/xoreaxeax/n/n3711c1318d0b>

Zenodo: <https://zenodo.org/records/15455079>

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