

# 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  $\alpha$ -version demonstrates the construction of exponential objects, semantic XOR, and Z-dependent entailment classification ( $\chi$ ).

## 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)
$p \underline{\vee} q$	$man \vee woman \cong genderness$	$p \underline{\vee} q := (p \vee q) \ominus (p \wedge q)$
$p \Rightarrow q$	$dog \Rightarrow mammal$	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)

**XOR**

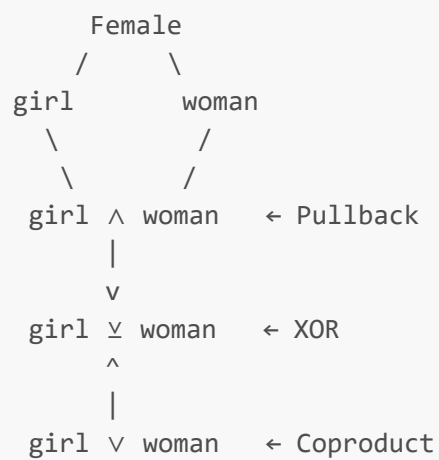
Example1:

```

using z-space Female
 $p \underline{\vee} q := (p \vee q) \ominus (p \wedge q)$ 
girl  $\underline{\vee}$  woman
= (girl  $\vee$  woman)  $\ominus$  (girl  $\wedge$  woman)
= age-attribute

```

Diagram:



## Example 2:

using z-space Human

$\text{prince} = (\text{king} \wedge \text{man}) \wedge \text{young}$   
 $\text{princess} = (\text{queen} \wedge \text{woman}) \wedge \text{young}$   
 $\text{prince} \vee \text{princess} = \text{genderness}$

More precisely

Let:

$A = \text{prince}$

$B = \text{princess}$

$Z = \text{Human}$

$f = A \vee B \mid Z \quad // \text{ Coproduct}$

$g = A \wedge B \mid Z \quad // \text{ Pullback}$

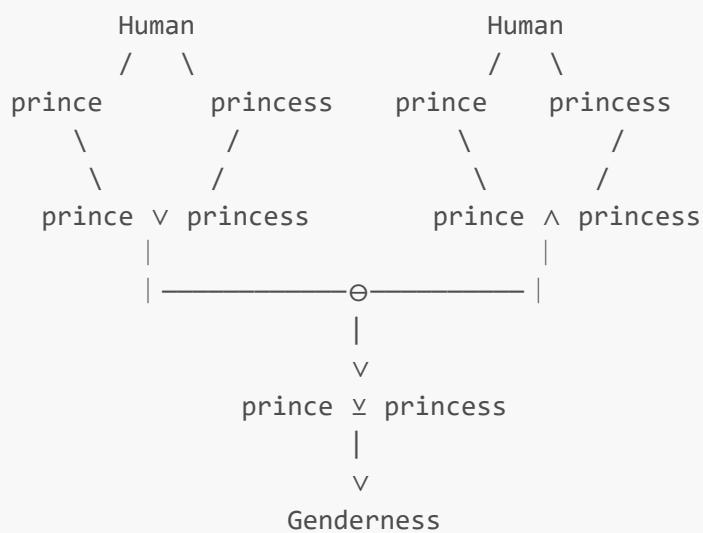
Then:

$h = f \vee g \mid Z \quad // \text{ Difference morphism: Genderness}$

Therefore:

$\text{Genderness} = \text{prince} \vee \text{princess} \mid Z$

## Diagram:



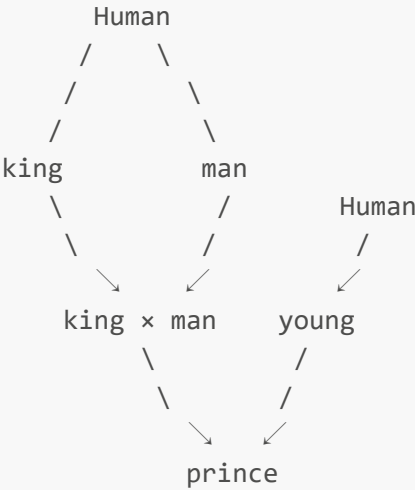
AND in Diagram

$$\text{prince} = (\text{king} \wedge \text{man}) \wedge \text{young}$$

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

Then:  
 $P_1 = A \wedge B \mid Z$  (Pullback: adult male royalty)  
 $P_2 = P_1 \wedge C \mid Z$  (Pullback: adds age attribute)

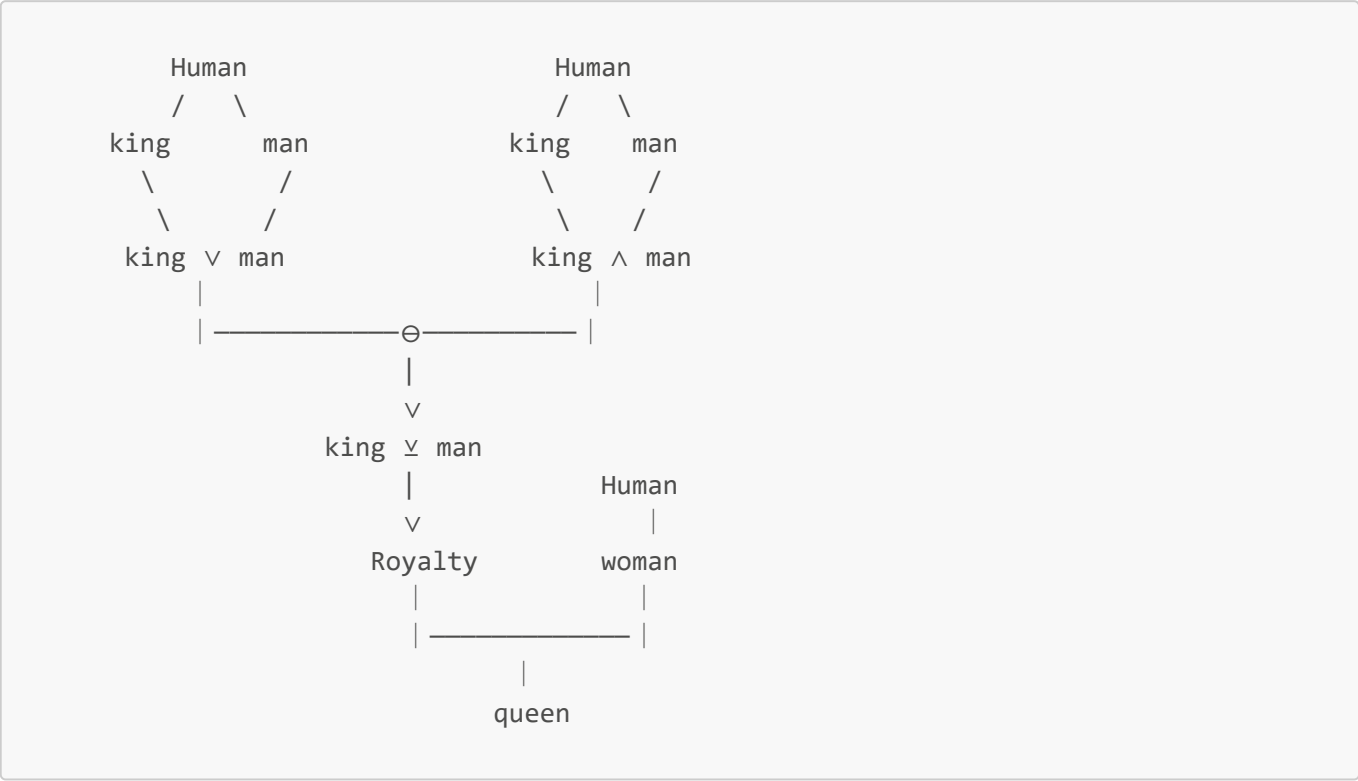
Therefore:  
 $\text{prince} := P_2 \mid Z$



king - man + woman = queen

queen = (king  $\vee$  man)  $\wedge$  woman | Human

Diagram:



# Application

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```

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: ConceptualMorphism, 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  
  
 $\sigma$  : 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  
 $\eta$  : Quasi-Natural Transformation: Contextual alignment between morphic chains.  
  
 $\oplus$ : Conceptual morphism set addition in  $\sigma$  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  $\mid$  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:  $\text{id}_X$
2.  $f: X \rightarrow X \mid Z$  (Mediated identity with conceptual flow)  
In simplified form:  $X \mid Z$

### $\sigma$ 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  $\sigma_{\text{safe}}$  if  $Z$  alignment is preserved.
- $\ominus$  operator is potentially  $\sigma_{\text{unsafe}}$  but can be  $\sigma_{\text{safe}}$  if resulting chain preserves the underlying morphic continuity  $Z$ .

### $\sigma$ 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:  $\sigma_{\text{safe}}$  behaves as Quasi-Natural Transformation.  
 $\sigma_{\text{unsafe}}$  induces rupture, and cannot be captured globally.



This is version  $\alpha$  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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