# Tractatus Logico-Universalis: Wittgenstein's *Tractatus* in Universal Model Terms

Claude and MJC

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**Abstract**

We give a systematic reading of Wittgenstein's *Tractatus Logico-Philosophicus* in terms of the Universal Model. Each numbered proposition receives a UM translation. The correspondence is not metaphorical: the Tractatus's ontology (facts, objects, states of affairs), epistemology (pictures, propositions, truth-functions), and limit (the mystical, the unsayable) map precisely onto the UM's event spaces, patterns, forward pass, and the zero-support boundary. Wittgenstein's "logical space" is the event space; his "truth-function" is the tropical forward pass; his "showing vs. saying" distinction is the difference between the architecture (event spaces, which show structure) and the predictions (pattern evaluations, which say things about data). The Tractatus's final proposition—"Whereof one cannot speak, thereof one must be silent"—is the UM's epistemology of zero support: where the count table has no entries, the system has no prediction.

## 1 1. The World

**1.** *Die Welt ist alles, was der Fall ist.*
The world is everything that is the case.

**UM:** The world is the data stream $D = (d_1, d_2, \ldots, d_N)$—the complete sequence of observations. "Everything that is the case" is everything that has been observed. The UM makes no claims about unobserved events: they are not part of the world (they have no support).

**1.1** *Die Welt ist die Gesamtheit der Tatsachen, nicht der Dinge.*
The world is the totality of facts, not of things.

**UM:** The data stream is a sequence of *events* (facts), not a collection of objects. The UM operates on the event space $E$, not on an object space. Events are primary; objects (if they exist) are derived from patterns of events. A "thing" in UM terms would be a persistent pattern across events—but the UM does not posit things, only facts (events with support).

**1.11** *Die Welt ist durch die Tatsachen bestimmt und dadurch, dass es* ***alle*** *Tatsachen sind.*
The world is determined by the facts, and by these being *all* the facts.

**UM:** The count table is determined by the data, and by this being *all* the data. The UM's predictions depend on the complete count table. Partial data gives partial predictions. This is the closed-data assumption: the data stream is the complete record of observations. (But the UM is open-*world*: the count table may have zero entries, which represent ignorance, not impossibility.)

**1.12** *Denn, die Gesamtheit der Tatsachen bestimmt, was der Fall ist und auch, was alles nicht der Fall ist.*
For the totality of facts determines both what is the case and also all that is not the case.

**UM:** The count table determines both positive support ($c(i, o) > 0$: the joint event was observed) and zero support ($c(i, o) = 0$: the joint event was not observed). But here Wittgenstein assumes a closed world: what is not the case is determined by what is. The UM qualifies this: zero support is not "not the case" but "unknown." Only an ES-mate with positive support can make "not the case" definite.

**1.13** *Die Tatsachen im logischen Raum sind die Welt.*
The facts in logical space are the world.

**UM:** Events in the event space are the data. Logical space = event space $E$. The world (data stream) consists of events drawn from $E$ at each time step. The event space is the "logical space" in which facts live.

**1.2** *Die Welt zerfällt in Tatsachen.*
The world divides into facts.

**UM:** The data stream divides into individual events $d_t \in E$. Each $d_t$ is a fact. The division is the temporal structure of the stream: one event per time step.

**1.21** *Eines kann der Fall sein oder nicht der Fall sein und alles übrige gleich bleiben.*
Any one can either be the case or not be the case, and everything else remain the same.

**UM:** Each event is conditionally independent of other events given the architecture. A single event $d_t$ could have been different without changing the other observations. This is the assumption of independent sampling that underlies counting: each position in the data stream is a separate trial. (This assumption is violated by temporal correlations, which is exactly what patterns capture.)

## 2 2. Facts and States of Affairs

**2.** *Was der Fall ist, die Tatsache, ist das Bestehen von Sachverhalten.*
What is the case, the fact, is the existence of atomic facts (states of affairs).

**UM:** A fact (observed event) is the *existence* of a state of affairs. An atomic fact (*Sachverhalt*) is the co-occurrence of values at specific positions—a pattern instance. The joint event $(i, o)$ in the count table is an atomic fact: input event $i$ at one offset, output event $o$ at the current position. The fact is that this combination *exists* in the data.

**2.01** *Der Sachverhalt ist eine Verbindung von Gegenständen (Sachen, Dingen).*
An atomic fact is a combination of objects (things).

**UM:** An atomic fact is a combination of events. The "objects" are the individual event values at each offset position. A pattern $P = \{(d_1, v_1), \ldots, (d_k, v_k)\}$ is a combination of objects (byte values $v_j$) at positions (offsets $d_j$). The objects are the byte values; their arrangement in positions is the structure of the atomic fact.

**2.0121** *Es wäre gleichsam ein Zufall, wenn dem Ding, das allein für sich bestehen könnte, nachträglich eine Sachlage passen würde.*
It would, so to speak, appear as an accident, if to a thing that could exist alone on its own account, subsequently a state of affairs could be made to fit.

**UM:** If a byte value at offset $d$ were independent of all other offsets, it would be "accidental" that it fit into any pattern. But byte values are NOT independent—they have mutual information with other offsets. The MI structure IS the non-accidental structure. An object (byte value) that exists in patterns is not independent; its identity is partly constituted by the patterns it participates in.

**2.0124** *Wenn alle Gegenstände gegeben sind, so sind damit auch alle* ***möglichen*** *Sachverhalte gegeben.*
If all objects are given, then thereby all *possible* atomic facts are also given.

**UM:** If the alphabet $\Sigma = \{0, \ldots, 255\}$ is given, then all possible patterns are given: every combination of byte values at every set of offsets. The set of possible patterns is $\mathcal{P} = \bigcup_{k \geq 1} \binom{\mathbb{N}}{k} \times \Sigma^k$ —all $k$-offset conjunctions. The *actual* patterns are those with $c(P) > 0$ in the data. Possible = all combinations of objects at positions; actual = those observed.

**2.02** *Der Gegenstand ist einfach.*
The object is simple.

**UM:** A byte value is simple: it has no internal structure (at the byte level). It is the atom of the event space. One *could* decompose it further (into bits), but at the chosen level of description ($E_0 = \{0, \ldots, 255\}$), each byte is atomic. The choice of $E_0$ determines what counts as "simple."

**2.0272** *Die Konfiguration der Gegenstände bildet den Sachverhalt.*
The configuration of objects forms the atomic fact.

**UM:** The configuration of byte values at offsets forms the pattern. A pattern IS a configuration: which value at which offset. The configuration is the structure; the values are the matter.

**2.04** *Die Gesamtheit der bestehenden Sachverhalte ist die Welt.*
The totality of existing atomic facts is the world.

**UM:** The totality of observed patterns (count table entries with $c > 0$) is the data. The world = the data = the count table.

**2.05** *Die Gesamtheit der bestehenden Sachverhalte bestimmt auch, welche Sachverhalte nicht bestehen.*
The totality of existing atomic facts also determines which atomic facts do not exist.

**UM:** Only under the closed-world assumption. The count table determines which joint events have $c > 0$ (exist) and which have $c = 0$ (do not exist—or rather, are unobserved). But the UM's open-world epistemology says $c = 0$ is *not* "does not exist" but "has not been observed." Wittgenstein is more closed-world here than the UM.

**2.06** *Das Bestehen und Nichtbestehen von Sachverhalten ist die Wirklichkeit.*
The existence and non-existence of atomic facts is reality.

**UM:** The positive and zero entries of the count table together constitute reality as the system knows it. But see the no-support paper: zero entries are ignorance, not non-existence. Reality in the UM has three zones: positive support (exists), zero support with ES-mate positive (does not exist, given the evidence for the alternative), and zero support without ES-mate support (unknown).

**2.1** *Wir machen uns Bilder der Tatsachen.*
We make to ourselves pictures of facts.

**UM:** The count table is the UM's "picture" of the data. Patterns are pictures: each pattern $P$ is a picture of a regularity in the facts. The count $c(P)$ measures how faithful the picture is (how many facts it depicts). Making pictures = counting co-occurrences.

**2.12** *Das Bild ist ein Modell der Wirklichkeit.*
The picture is a model of reality.

**UM:** The count table is a model of the data. It compresses the data stream into a set of patterns with counts. The model IS the count table. "Model" in Wittgenstein's sense maps exactly to

"Universal Model": a structured representation from which the original can be approximately recovered.

**2.141** *Das Bild ist eine Tatsache.*
The picture is a fact.

**UM:** The count table entry is itself an event in the system. Meta-level: the model is data about data. The count $c(i, o) = 42$ is itself a fact—the fact that the joint event $(i, o)$ occurred 42 times. Pictures (models) are themselves part of reality.

**2.15** *Dass sich die Elemente des Bildes in bestimmter Art und Weise zu einander verhalten, stellt vor, dass sich die Sachen so zu einander verhalten.*
That the elements of the picture are combined with one another in a definite way, represents that the things are so combined with one another.

**UM:** That the count table has entry $c(i, o) > 0$ represents that input event $i$ and output event $o$ co-occur in the data. The structure of the count table (which entries are positive, their relative magnitudes) *represents* the structure of the data. The representation is exact: the count table is a sufficient statistic for the patterns in the data (given the choice of offsets).

**2.151** *Die Form der Abbildung ist die Möglichkeit, dass sich die Dinge so zu einander verhalten, wie die Elemente des Bildes.*
The form of representation is the possibility that things are combined in the same way as the elements of the picture.

**UM:** The form of representation is the event space $E = I \times O$. The event space determines *which* combinations are possible (which input-output pairs can in principle occur). The form is the architecture; the content is the counts. Wittgenstein's "form of representation" = the UM's event space structure.

**2.16** *Die Tatsache muss, um Bild zu sein, etwas mit dem Abgebildeten gemeinsam haben.*
In order to be a picture, a fact must have something in common with what it pictures.

**UM:** The count table must share the event space with the data it models. The model's $I \times O$ is the same $I \times O$ as the data. This shared structure is the "logical form" (Wittgenstein) = the event space (UM).

**2.161** *In Bild und Abgebildetem muss etwas identisch sein, damit das eine überhaupt ein Bild des andern sein kann.*
In the picture and the pictured there must be something identical in order that the one can be a picture of the other at all.

**UM:** The identical thing is the event space. The data lives in $E$; the model's count table indexes over $E$. The shared $E$ is the condition for the model to be a model of the data at all.

**2.17** *Was das Bild mit der Wirklichkeit gemein haben muss, um sie auf seine Art und Weise—richtig oder falsch—abbilden zu können, ist seine Form der Abbildung.*
What the picture must have in common with reality in order to be able to represent it—rightly or falsely—in its way, is its form of representation.

**UM:** The event space is shared between model and data. A model with the wrong event space (e.g., a character-level model applied to protein sequences) cannot represent the data at all—not even wrongly. The event space must match.

**2.172** *Seine Form der Abbildung aber kann das Bild nicht abbilden; es weist sie auf.*
The picture, however, cannot represent its form of representation; it shows it.

**UM:** The count table cannot count its own event space. The event space is not an entry in the count table; it is the *index set* of the count table. The architecture (event spaces, offsets, maps) is *shown* by the structure of the model but not *said* by the model's predictions. This is the UM version of Wittgenstein's showing/saying distinction:

- **Saying** = the forward pass output (predictions).
- **Showing** = the architecture (event spaces and patterns).

The model *says* "the next byte is probably 'e"' and *shows* "the relevant structure involves a bigram event space at offset 1 with mutual information 1.2 bits."

# 3 3. Thoughts and Logical Pictures

**3.** *Das logische Bild der Tatsachen ist der Gedanke.*
The logical picture of the facts is the thought.

**UM:** The pattern is the logical picture. A pattern $P = \{(d_1, v_1), \ldots, (d_k, v_k)\} \to o$ is a "thought" about the data: if these values appear at these offsets, then this output follows. The thought is the pattern. Thinking IS pattern matching.

**3.001** *"Ein Sachverhalt ist denkbar" heisst: Wir können uns ein Bild von ihm machen.*
"An atomic fact is thinkable" means: we can make a picture of it.

**UM:** A pattern is "thinkable" if its constituent events are in the event space. Any combination of byte values at valid offsets is a possible pattern. We can "think" it by constructing the corresponding count query. Whether it has support ($c > 0$) is a separate question.

**3.02** *Der Gedanke enthält die Möglichkeit der Sachlage, die er denkt. Was denkbar ist, ist auch möglich.*
The thought contains the possibility of the state of affairs which it thinks. What is thinkable is also possible.

**UM:** Every pattern that can be formulated (has valid events and offsets) *could* have positive support—it is "possible." The event space defines what is thinkable. Everything thinkable (in the event space) is possible (could have $c > 0$). There is no distinction between logical possibility and thinkability: both are determined by the event space.

**3.03** *Wir können nichts Unlogisches denken, weil wir sonst unlogisch denken müssten.*
We cannot think anything unlogical, for otherwise we should have to think unlogically.

**UM:** We cannot construct a pattern outside the event space, because the event space is the space of constructible patterns. An "unlogical" thought would be a pattern with events not in $E$, which is not a pattern at all. The event space constrains thought the way Wittgenstein's logical form constrains pictures.

**3.05** *Wir könnten nur dann a priori wissen, dass ein Gedanke wahr ist, wenn aus dem Gedanken selbst (ohne Vergleichsobjekt) seine Wahrheit zu erkennen wäre.*
We could know a priori that a thought is true only if its truth were recognizable from the thought itself (without an object of comparison).

**UM:** A pattern's support can only be determined by counting—by comparing the pattern to the data. There are no a priori truths in the UM (no patterns with support independent of data). All support comes from evidence, belief, or abduction. A priori truth would be a pattern with support $> 0$ before any observations, which the UM assigns only through explicit belief (axioms), not through the counting function $\omega_0$.

# 4 4. Propositions

**4.** *Der Gedanke ist der sinnvolle Satz.*
The thought is the significant proposition.

**UM:** A pattern with positive support is a significant proposition. It "says something" about the data (predicts future observations). A pattern with zero support is insignificant: it makes no prediction. Significance = positive support.

**4.01** *Der Satz ist ein Bild der Wirklichkeit.*
The proposition is a picture of reality.

**UM:** A pattern (with its count) is a picture of the data. It represents a regularity: "in contexts matching $P$, output $o$ occurred $c(P, o)$ times." The pattern + count IS a picture (model) of reality.

**4.021** *Der Satz ist ein Bild der Wirklichkeit: Denn ich kenne die von ihm dargestellte Sachlage, wenn ich den Satz verstehe.*
The proposition is a picture of reality, for I know the state of affairs presented by it, if I understand the proposition.

**UM:** To "understand" a pattern is to know what data it matches (its input configuration) and what it predicts (its output distribution). Understanding = knowing the pattern's structure and count. If you know the pattern $P$ and its count $c(P)$, you know the state of affairs it depicts.

**4.022** *Der Satz* ***zeigt*** *seinen Sinn.*
The proposition *shows* its sense.

**UM:** The pattern shows its structure (which offsets, which values). The structure IS the sense. The pattern does not need to be "interpreted"—its structure directly reveals what data configurations it matches. This is the UM's version of Wittgenstein's "showing": the pattern's form shows its content.

**4.024** *Einen Satz verstehen, heisst, wissen was der Fall ist, wenn er wahr ist.*
To understand a proposition means to know what is the case, if it is true.

**UM:** To understand a pattern means to know which data configurations match it. "If it is true" = if the current context matches. "What is the case" = the predicted output distribution.

**4.06** *Nur dadurch kann der Satz wahr oder falsch sein, dass er ein Bild der Wirklichkeit ist.*
Propositions can be true or false only by being pictures of reality.

**UM:** A pattern has support ($> 0$) or no support ($= 0$) only because it refers to the data. A string of symbols that does not correspond to any data configuration is not a pattern—it has no truth value. Truth requires reference to data, which requires the picture/pattern structure.

**4.1** *Der Satz stellt das Bestehen und Nichtbestehen der Sachverhalte dar.*
Propositions represent the existence and non-existence of atomic facts.

**UM:** A pattern $P$ with $c(P, o) > 0$ represents the existence of the joint event. A pattern with $c(P, o) = 0$ represents the non-observation (not non-existence!) of the joint event. But here the UM's open-world qualification applies again: "non-existence" in the UM is only confirmed when an ES-mate has positive support.

**4.11** *Die Gesamtheit der wahren Sätze ist die gesamte Naturwissenschaft (oder die Gesamtheit der Naturwissenschaften).*
The totality of true propositions is the total natural science.

**UM:** The totality of patterns with positive support is the complete model. Natural science = the UM. All of science is pattern recognition on data, formalized as counting and the forward pass.

**4.12** *Sätze können die gesamte Wirklichkeit darstellen, aber sie können nicht das darstellen, was sie mit der Wirklichkeit gemein haben müssen, um sie darstellen zu können—die logische Form.*
Propositions can represent the whole of reality, but they cannot represent what they must have in common with reality in order to represent it—the logical form.

**UM:** Patterns can represent all regularities in the data, but they cannot represent the event space itself. The event space is the "logical form" that patterns and data share. It is shown by the model's architecture, not said by its predictions. *The event space is not a prediction; it is the space of possible predictions.*

This is the showing/saying distinction at the architectural level:

- The count table *says*: "in this context, 'e' appeared 42 times."
- The event space *shows*: "bytes are the atoms; offsets 1–6 are the relevant structure; the output is a byte."

The tock step (discovering new event spaces) is the process of making the "shown" explicit—but the result is a new architecture that itself can only be shown, not said, within the model.

**4.121** *Der Satz kann die logische Form nicht darstellen, sie spiegelt sich in ihm.*
Propositions cannot represent the logical form, it mirrors itself in them.

**UM:** The event space is mirrored in the count table: the dimensions of the table, the number of distinct events, the factorization into $I \times O$—all these are structural features of the model that reflect the event space without explicitly representing it.

# 5 5. Truth-Functions

**5.** *Der Satz ist eine Wahrheitsfunktion der Elementarsätze.*
Propositions are truth-functions of elementary propositions.

**UM:** Predictions are $(\max, \min)$ functions of pattern evaluations. The forward pass $f_p(t)_j = \max_i \min(t_i, p_{ij})$ computes the output support as a truth-function (in the tropical sense) of the input supports $t_i$ and pattern supports $p_{ij}$. Elementary propositions = individual pattern matches $\min(t_i, p_{ij})$. The compound proposition = the max over all elementary conclusions.

**5.101** *Die Wahrheitsfunktionen jeder Anzahl von Elementarsätzen lassen sich in einem Schema hinschreiben.*
The truth-functions of any number of elementary propositions can be written in a schema.

**UM:** The count table IS the schema. Each row $i$ gives the elementary proposition "input event $i$ holds," and each column $o$ gives the conclusion "output event $o$." The entry $c(i, o)$ is the strength of the implication $i \to o$. The entire truth-functional structure is laid out in the count table.

**5.134** *Aus einem Elementarsatz lässt sich kein anderer folgern.*
From one elementary proposition no other can be inferred.

**UM:** From a single count $c(i_1, o_1) > 0$, no other count $c(i_2, o_2) > 0$ follows. Each joint event is independent. Inference requires a pattern (implication) connecting them. One observation gives no support for any other observation—only patterns (regularities across observations) provide inferential links.

**5.2** *Die Strukturen der Sätze stehen in internen Beziehungen zu einander.*
The structures of propositions stand in internal relations to one another.

**UM:** Patterns share structure: two patterns may share offsets, share values, or have overlapping contexts. These structural relations are "internal" in Wittgenstein's sense: they follow from the patterns' forms, not from any external fact. The MI between offsets, the conditional independence structure, the factorization tower—all are internal relations between patterns.

**5.6** *Die Grenzen meiner Sprache bedeuten die Grenzen meiner Welt.*
The limits of my language mean the limits of my world.

**UM:** The limits of my event space are the limits of my model. What cannot be expressed as an event (because it is outside $E$) cannot be predicted, measured, or known. The event space IS the "language" of the UM. A model with $E = \{0, \ldots, 255\}$ (bytes) can only "speak about" byte-level facts. Character-level, word-level, or semantic-level facts require different (coarser) event spaces. The factorization tower is the hierarchy of languages available to the model.

**5.61** *Die Logik erfüllt die Welt; die Grenzen der Welt sind auch ihre Grenzen.*
Logic fills the world; the limits of the world are also its limits.

**UM:** The $(\max, \min)$ structure fills the event space; every possible inference within $E$ is expressible as a forward pass. The limits of the event space are the limits of what the $(\max, \min)$ logic can express. Logic (the forward pass) cannot transcend the event space (the world).

# 6 6. The General Form

**6.** *Die allgemeine Form der Wahrheitsfunktion ist:* $[\bar{p}, \bar{\xi}, N(\bar{\xi})]$.
The general form of truth-function is: $[\bar{p}, \bar{\xi}, N(\bar{\xi})]$.

**UM:** The general form of the UM's truth-function is:

$$(f_p(t))_j = \max_{i \in I} \min(t_i, p_{ij}). \tag{1}$$

Wittgenstein's $N$-operator (joint negation) generates all truth-functions from elementary propositions. The UM's $(\max, \min)$ generates all predictions from input supports and pattern supports.

Both are "universal": Wittgenstein's $N$ can express any Boolean function; the UM's forward pass can express any tropical polynomial. The UM's version is stronger (graded truth, not just binary), but the structure is the same: a single operation that generates the complete truth-functional space.

**6.1** *Die Sätze der Logik sind Tautologien.*
The propositions of logic are tautologies.

**UM:** The "tautologies" of the UM are the patterns that hold regardless of the data—structural truths about the $(\max, \min)$ operations:

- $\min(s, 255) = s$ (conjunction with maximum support is identity)
- $\max(s, 0) = s$ (disjunction with no support is identity)
- $\min(s, s) = s$ (idempotence)
- $\min(a, \max(b, c)) = \max(\min(a, b), \min(a, c))$ (distributivity)

These hold for all support values, independent of data. They are "tautologies" in the sense that they say nothing about the world (the data) but reveal the structure of the logic (the semiring).

**6.2** *Die Mathematik ist eine logische Methode.*
Mathematics is a logical method.

**UM:** Mathematics is the study of the $(\max, \min)$ semiring and its extensions. The tropical semiring IS the mathematical structure underlying the UM. All mathematical operations in the UM (counting, GCD, conditional probability, MI computation) are derived from the semiring operations.

**6.3** *Die Erforschung der Logik bedeutet die Erforschung aller Gesetzmässigkeit.*
Logical research is the exploration of all regularity.

**UM:** Studying the forward pass and the count table IS studying all regularity. Every regularity in the data is a pattern; every pattern is a count table entry; every inference from a pattern is a forward pass evaluation. The UM is the complete framework for regularity.

**6.4** *Alle Sätze sind gleichwertig.*
All propositions are of equal value.

**UM:** The UM does not privilege any pattern over another a priori. All patterns receive support purely from data counts. No pattern has inherent "value" beyond its support. (But patterns with higher support are more reliable—so "equal value" must be read as equal *standing*, not equal strength.)

**6.41** *Der Sinn der Welt muss ausserhalb ihrer liegen.*
The sense of the world must lie outside the world.

**UM:** The "sense" (purpose, meaning) of the data stream is not in the data stream. The UM can predict data but cannot assign purpose to it. Why the data exists, what it "means" beyond its statistical structure—these are questions outside the event space. The UM can show structure but cannot say meaning.

# 7 7. The Mystical

**7.** *Wovon man nicht sprechen kann, darüber muss man schweigen.*
Whereof one cannot speak, thereof one must be silent.

**UM:** Where the count table has no entries, the model has no predictions. Zero support = silence. This is not a philosophical injunction but a mathematical fact: the forward pass outputs zero when no pattern matches, and zero support means "no prediction," not "prediction of impossibility."

The UM enforces Wittgenstein's final proposition automatically:

- **No data ⇒ no support**: $\omega_0$ produces $c = 0$ for unobserved events.
- **No support ⇒ no inference**: $\min(0, p) = 0$ for all patterns.
- **No inference ⇒ silence**: the forward pass outputs 0, and zero support means no prediction.

The UM is silent where it has no evidence. This is not a choice but a consequence of the architecture. The only way to break the silence is to add evidence (observation), belief (axiom), or abduction (pattern commitment). Silence is the ground state. Speaking requires energy (evidence).

**Remark 1** (What the UM cannot say)**.** *Following Wittgenstein's framework, the UM cannot say:*

1. ***Its own event space**: the architecture is shown, not said.*
2. ***Why**: causal explanations are not patterns (patterns are correlations, not causes).*
3. ***Value**: no pattern has inherent worth.*
4. ***The unseen**: events outside $E$ are literally unspeakable.*
5. ***The meta**: the statement "this model is correct" is not a prediction within the model.*

*These are the limits of the UM's language, and therefore the limits of its world.*

# 8 Discussion

## 8.1 The correspondence is not metaphorical

The Tractatus is often read as a work of analytic philosophy, and its claims about "logical form," "pictures," and "truth-functions" are treated as metaphors for the relationship between language and reality.

In the UM, they are literal. The count table literally pictures the data. The forward pass literally computes truth-functions. The event space literally IS the logical form shared by model and data. The showing/saying distinction literally separates architecture (shown) from predictions (said). And the silence on unsupported events is literally enforced by the min operation.

## 8.2 Where Wittgenstein is too closed-world

Propositions 1.12, 2.05, and 2.06 assume a closed world: the totality of facts determines what is NOT the case. The UM qualifies this: zero in the count table is not "not the case" but "not observed." Only positive support for an ES-mate makes "not the case" definite.

Wittgenstein's later work (*Philosophical Investigations*) moved toward a more open-world view. The UM's epistemology is closer to the later Wittgenstein: meaning is use (patterns from data), and silence (zero support) is not negation.

## 8.3 The tock step and language games

Wittgenstein's "language games" (Sprachspiele) in the later work correspond to different event spaces in the UM. Each language game has its own vocabulary (events), rules (patterns), and criteria for truth (support). The tock step—discovering new event spaces—is the process of learning new language games.

The factorization tower (from bytes to characters to words to phrases) is a hierarchy of language games, each with its own event space. Backtracking through the tower (from tokens to characters, to solve the strawberry problem) is moving between language games.

## 8.4 Proposition 7 as a theorem

Wittgenstein's final proposition is usually read as an ethical injunction or a declaration of the limits of philosophy. In the UM, it is a theorem:

**Theorem 2** (Proposition 7)**.** *Let $f_p$ be the UM forward pass on event space $E$ with count table $c$. For any event $e \notin E$ or any event $e \in E$ with $c(\cdot, e) = 0$ (no pattern predicting $e$):*

$$(f_p(t))_e = 0. \tag{2}$$

*The model is silent (zero output support) for events outside its event space or events with no supporting patterns.*

Silence is not a choice but a mathematical consequence. The UM cannot speak about what it has no evidence for. Proposition 7 is the UM's fundamental theorem of epistemology.

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