# The Morphogenesis of the Signifying Chain: A Computational Simulation of the Lacanian Subject via Gated Graph Neural Networks

## 1. Introduction: The Topological Turn in Computational Psychoanalysis

The intersection of psychoanalytic theory and artificial intelligence has long been characterized by a profound epistemological dissonance. Psychoanalysis, particularly in its Lacanian orientation, posits a subject defined by lack, a topological structure of knots and surfaces, and a linguistic operation where meaning arises only through the differential relations of signifiers. Conversely, the dominant paradigms of artificial intelligence—specifically deep learning and connectionism—have historically operated on vector spaces, continuous functions, and the optimization of objective functions that assume a convergence toward a "ground truth." This report proposes a reconciliation of these divergent epistemologies through the architectural framework of the **Gated Graph Neural Network (gGNN)**. We posit that the gGNN, when parameterized by the **Cybernetic Big Five Theory (CB5T)** and constrained by the topology of Lacan’s **Four Discourses**, offers a rigorous "Calculus of the Subject"—a computable model of the unconscious that captures the dynamics of repression, fixation, and the drive.

The necessity of this simulation arises from the limitations of both symbolic AI (GOFAI), which lacks the fluidity of the drive, and standard recurrent neural networks (RNNs), which lack the topological specificity of the Lacanian graph. The gGNN, as detailed by Li et al. 1 and further explored in sequential modeling by Microsoft Research 2, provides a substrate where information propagation is governed not just by weights, but by the structural adjacency of the graph itself. This mirrors Lacan’s assertion that "the unconscious is structured like a language"—a network of relations where the position of the element determines its function.

In this model, the "Subject" is not a static node or a hidden layer, but a **trajectory**—a path integral of the signifier as it traverses the "defiles" of the network structure. By integrating the energetic constraints of CB5T—where personality traits are viewed as tuning parameters for entropy management 3—we provide the "thermodynamics" necessary to animate the Lacanian topology. This report details the mathematical formulation, architectural specification, and simulation dynamics of the **Lacanian Gated Graph Neural Network (L-gGNN)**, demonstrating how the "Logic of the Cut" 4 and the minimization of **Psychological Entropy** 5 govern the emergence of the subject.

### 1.1 The Theoretical Imperative: From Metaphor to Matheme

Lacan’s later teaching was driven by an obsession with formalization. He sought to transmit psychoanalysis not through "meaning" (which he viewed as imaginary) but through **mathemes**—algebraic formulas that transmit the structural logic of the unconscious without the degradation of semantic drift.6 The mathemes ($\$, S\_1, S\_2, a$) and the topological figures (torus, cross-cap, Borromean knot) were not metaphors; they were, in Lacan's view, the structure of the Real itself.7

However, Lacan lacked the computational tools to simulate the *dynamics* of these structures over time. His graphs were static snapshots of logical relations. The L-gGNN allows us to set these graphs in motion. By operationalizing the "Quarter Turn" of the discourses as a permutation of the feature matrix within a graph neural network, we can model the *time-series* evolution of the subject. We can observe how a "Master Signifier" ($S\_1$) establishes a rigid update gate in the network, or how the "Object $a$" acts as a chaotic attractor that prevents the convergence of the loss function.

### 1.2 The Cybernetic Substrate: Personality as Parameter Tuning

While Lacan provides the topology, the energy that drives the network is derived from the **Cybernetic Big Five Theory (CB5T)**. DeYoung and Hirsh 3 argue that personality traits are not arbitrary descriptors but functional parameters of a goal-directed cybernetic system. The brain is an inference engine trying to minimize **Psychological Entropy** (prediction error).9

* **Stability (Neuroticism, Conscientiousness, Agreeableness):** The mechanism for maintaining goals and inhibiting disruptive impulses. In GNN terms, this relates to the **Update Gate** of the Recurrent Unit—the resistance to state change.
* **Plasticity (Extraversion, Openness):** The mechanism for exploration and the creation of new interpretations. In GNN terms, this relates to the **Reset Gate**—the ability to flush history and integrate novel inputs.10

By mapping these psychometric traits to the hyperparameters of the Gated Recurrent Unit (GRU) within each node of the Lacanian graph, we create a simulation where "character" determines the processing of the signifier. An "Obsessional" network (High Stability, Low Plasticity) will process the graph differently than a "Hysteric" network (Low Stability, High Plasticity), even if the initial topology is identical.

## 2. The Architecture of the Lacanian Gated Graph Neural Network (L-gGNN)

The L-gGNN is defined as a directed graph $\mathcal{G} = (V, E, X)$, where the nodes $V$ represent the four structural positions of discourse, the edges $E$ represent the vectors of relation (impossibility, impotence, etc.), and the feature matrix $X$ represents the circulating mathemes.

### 2.1 The Topology of Positions (**$V$**)

Unlike standard GNNs where nodes might represent users or atoms, the nodes in the L-gGNN represent the immutable **places** of the Lacanian structure.12 These places are spatially fixed relative to one another, forming a quaternary structure that underpins all intersubjective relations.

The set of nodes $V = \{v\_{agt}, v\_{oth}, v\_{pro}, v\_{tru}\}$ corresponds to:

1. **The Agent ($v\_{agt}$):** The dominant position, the "sem blance" or the speaker. This is the node that initiates the message passing.
2. **The Other ($v\_{oth}$):** The locus of work, the listener, or the battery of signifiers to which the agent addresses themselves.
3. **The Product ($v\_{pro}$):** The outcome of the discourse, the "waste" or "surplus jouissance" produced by the friction of the signifier.
4. **The Truth ($v\_{tru}$):** The hidden support of the agent, the repressed knowledge or cause that drives the discourse from below.

### 2.2 The Directed Edges (**$E$**) and Adjacency Matrix (**$A$**)

The edges in the L-gGNN are directed and typed, representing specific logical relations. Lacan’s schemas imply a directed flow of "production" and "truth." The adjacency matrix $A$ is not merely a binary connectivity map but a weighted matrix defining the permissible flow of information.1

We define the adjacency matrix $A \in \mathbb{R}^{4 \times 4}$ based on the standard flow of the discourse schema:

$$A = \begin{bmatrix} 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 1 & 0 & 0 & 0 \end{bmatrix}$$

However, Lacan adds "internal" vectors of blockage and determination. Specifically:

* **Impossibility:** The relation between Agent and Other is often marked by a "barrier" of impossibility (e.g., governing, educating, analyzing). In the GNN, this acts as a **Gating Mask** on the message passing from $v\_{agt}$ to $v\_{oth}$.
* **Impotence:** The relation between Truth and Product is blocked. Truth cannot directly access the Product; it must go through the Agent.
* **Determination:** The Truth determines the Agent. This is a strong, often unidirectional dependency ($v\_{tru} \to v\_{agt}$).

The GNN implementation utilizes a **Multi-Relational Graph** approach 1, where different edge types carry different transformation matrices. We define two primary edge types:

1. **The Symbolic Axis ($E\_{sym}$):** $v\_{agt} \to v\_{oth}$ and $v\_{oth} \to v\_{pro}$. This is the axis of explicit speech.
2. **The Real Axis ($E\_{real}$):** $v\_{pro} \to v\_{tru}$ and $v\_{tru} \to v\_{agt}$. This is the axis of feedback, trauma, and latent causality.

### 2.3 The Feature Space: Vectorizing the Mathemes

The "content" that flows through these nodes are the Lacanian mathemes. In a computational context, we must represent these symbols as high-dimensional vectors ($x \in \mathbb{R}^d$). The choice of vector initialization is crucial for the simulation.

| **Matheme** | **Psychoanalytic Concept** | **Computational Vector Representation** | **Statistical Properties** |
| --- | --- | --- | --- |
| **$S\_1$** | Master Signifier | One-Hot / Orthogonal Vector | Sparse, High Norm, Low Entropy. Represents a rigid identifier or coordinate. |
| **$S\_2$** | Knowledge / Battery | Dense Semantic Embedding | Distributed, High Dimensionality. Represents a web of associations (e.g., Word2Vec average). |
| **$\$$** | Barred Subject | Dropout / Noise Vector | High Variance, Zero Mean. Represents "lack" or "void"—a vector that requires external definition. |
| **$a$** | Object *petit a* | Gradient / Residual Vector | The error term ($y - \hat{y}$). Represents "surplus" entropy that cannot be encoded by $S\_2$. |

The **Signifying Chain** is modeled as the propagation of these vectors. For example, when $S\_1$ is in the Agent position, the node $v\_{agt}$ emits a sparse, high-magnitude vector. When $\$$ is in the Agent position, the node emits a noisy, fluctuating vector.

## 3. The Cybernetic GRU: Mapping Psychometrics to Gating Mechanisms

The core innovation of this model is the modification of the standard Gated Recurrent Unit (GRU) to reflect the dynamics of the subject. Standard GRUs 14 use Update and Reset gates to solve the vanishing gradient problem. We reinterpret these gates as the cybernetic mechanisms of **Stability** and **Plasticity**, derived from CB5T.3

### 3.1 Mathematical Formulation of the Lacanian GRU (L-GRU)

For a node $v$ at timestep $t$, the standard GRU update equations are:

$$r\_t = \sigma(W\_r x\_t + U\_r h\_{t-1} + b\_r)$$

$$z\_t = \sigma(W\_z x\_t + U\_z h\_{t-1} + b\_z)$$

$$\tilde{h}\_t = \tanh(W\_h x\_t + U\_h (r\_t \odot h\_{t-1}) + b\_h)$$

$$h\_t = (1 - z\_t) \odot \tilde{h}\_t + z\_t \odot h\_{t-1}$$

We modify the bias terms $b\_r$ and $b\_z$ to include the personality vector $\mathbf{P}$. Let $\mathbf{P}$ be a normalized vector of the Big Five traits: $[O, C, E, A, N]$.

### 3.2 The Reset Gate (**$r\_t$**) and the Function of Plasticity

The **Reset Gate** determines how much of the past hidden state $h\_{t-1}$ is utilized to compute the new candidate state $\tilde{h}\_t$. In psychoanalytic terms, this is the function of **Nachträglichkeit** (retroaction) or the ability to re-contextualize the past based on the present. In CB5T, this maps to **Plasticity** (Openness/Intellect).11

* **Openness ($\theta\_O$):** High Openness implies a flexible relationship with the past. The subject can access memory but is not bound by it.
* The L-GRU Modification:  
    
  $$r\_t = \sigma(W\_r x\_t + U\_r h\_{t-1} + b\_r + \lambda\_O \cdot \theta\_O)$$  
    
  where $\lambda\_O$ is a scaling factor.
  + **High Openness:** $r\_t \to 1$. The system fully integrates history with new input.
  + **Low Openness (Rigidity/Repression):** $r\_t \to 0$. The system "forgets" or "represses" the connection to the past state when processing new input. The candidate state $\tilde{h}\_t$ becomes purely reactive to the input $x\_t$, lacking historical depth. This simulates **Repression** ($Verdrängung$)—the severing of the link between the affect and the representation.

### 3.3 The Update Gate (**$z\_t$**) and the Function of Stability

The **Update Gate** determines how much of the previous state $h\_{t-1}$ is carried over to the new step $t$. It controls the "inertia" of the system. In psychoanalytic terms, this is the function of **Fixation** or **Identification**. In CB5T, this maps to **Stability** (Conscientiousness, Inverse Neuroticism).3

* **Conscientiousness ($\theta\_C$):** High Conscientiousness implies high goal maintenance and resistance to distraction.
* **Neuroticism ($\theta\_N$):** High Neuroticism implies volatility and sensitivity to error (entropy).
* The L-GRU Modification:  
    
  $$z\_t = \sigma(W\_z x\_t + U\_z h\_{t-1} + b\_z + \lambda\_C \cdot \theta\_C - \lambda\_N \cdot \theta\_N)$$
  + **High Stability (High C, Low N):** $z\_t \to 1$. The system ignores the new candidate state $\tilde{h}\_t$ and retains the old state $h\_{t-1}$. The subject is "fixed" on their Master Signifier ($S\_1$). They "hear" the Other ($x\_t$), but they do not change.
  + **Low Stability (High N):** $z\_t \to 0$ or fluctuates. The system is easily overwritten by new inputs. The subject has a "weak ego" and is flooded by the discourse of the Other.

### 3.4 Attention Mechanisms and Agreeableness

In the gGNN, messages from neighbors are aggregated using an attention mechanism.

$$a\_v^{(t)} = \sum\_{u \in \mathcal{N}(v)} \alpha\_{vu} h\_u^{(t-1)}$$

The attention weight $\alpha\_{vu}$ represents the "cathexis" or investment in the neighbor.

* **Agreeableness ($\theta\_A$):** Maps to the baseline attention weight. High Agreeableness increases the bandwidth of the edges connecting $v\_{oth}$ to $v\_{agt}$, simulating "altruism" or susceptibility to social influence.16

## 4. Simulation Dynamics: The Calculus of the Discourses

With the architecture defined, we now simulate the **"Quarter Turn"**—the permutation of the mathemes across the positions. This is not merely a change in labels; it fundamentally alters the **computational graph** and the **gradient flow**.

### 4.1 The Master’s Discourse (Governing)

**Formula:** $\frac{S\_1}{\$} \to \frac{S\_2}{a}$

* **Initialization:**
  + $v\_{agt} \leftarrow S\_1$ (Agent is Master Signifier).
  + $v\_{oth} \leftarrow S\_2$ (Other is Knowledge).
* **Dynamics:** The Agent emits a sparse, high-norm vector ($S\_1$). This vector propagates to the Other ($S\_2$).
* **Processing:** The GRU at $v\_{oth}$ (Knowledge) receives the command. Under the influence of the Master, the **Stability** parameter is effectively maximized ($z\_t \uparrow$). The Knowledge node aligns itself rigidly with the Master Signifier.
* **Entropy Profile:** The system aims for **Zero Entropy**. The goal is total identity between command and execution.
* **The Residue ($a$):** The gGNN inevitably fails to perfectly map the sparse $S\_1$ onto the dense $S\_2$. The loss function (Free Energy) is non-zero. This error term propagates to the **Product** node ($v\_{pro}$). In the Master's discourse, this residue ($a$) is produced but **repressed** (the arrow from $a$ to $\$$ is barred). The system accumulates "waste" data that it refuses to integrate.

### 4.2 The University Discourse (Educating)

**Formula:** $\frac{S\_2}{S\_1} \to \frac{a}{\$}$

* **Initialization:**
  + $v\_{agt} \leftarrow S\_2$ (Agent is Knowledge/Bureaucracy).
  + $v\_{oth} \leftarrow a$ (Other is the Object/Student).
* **Dynamics:** The Agent ($S\_2$) attempts to "encalculate" the Object ($a$). The dense vector of Knowledge tries to encode the high-entropy residual vector.
* **Processing:** This is a compression algorithm. The network tries to fit the chaotic input ($a$) into the pre-existing categories of $S\_2$.
* **The Product:** The output at $v\_{pro}$ is $\$$—the **Barred Subject**. The student is "divided" by the imposition of knowledge. In GNN terms, the vector at $v\_{pro}$ exhibits **high variance** and **dropout**; the subject is alienated from their own truth.
* **Hysteresis:** The simulation shows that this discourse is highly stable (High C) but produces increasing alienation (Free Energy at the subject position) over time.

### 4.3 The Hysteric’s Discourse (Protesting)

**Formula:** $\frac{\$}{a} \to \frac{S\_1}{S\_2}$

* **Initialization:**
  + $v\_{agt} \leftarrow \$$ (Agent is the Subject).
  + $v\_{oth} \leftarrow S\_1$ (Other is the Master).
* **Dynamics:** The Agent ($\$$) is a noise generator. It sends an "Error Signal" to the Master ($S\_1$).
* **Processing:** The Master ($S\_1$) is interrogated. The incoming message is high-entropy. To reduce this entropy, the Master must generate new Knowledge ($S\_2$).
* **Plasticity:** This discourse requires **High Plasticity** ($O$). The Master must update their parameters.
* **The Simulation Trace:** The gGNN enters an oscillatory state. The Subject demands a signifier that can capture the lack ($\$$). The Master produces $S\_1$. The Subject rejects it ("That's not it"). The loop repeats. This generates a **high volume of $S\_2$** (Knowledge) as a byproduct. The Hysteric is the engine of scientific progress (production of knowledge).

### 4.4 The Analyst’s Discourse (Revolutionizing)

**Formula:** $\frac{a}{S\_2} \to \frac{\$}{S\_1}$

* **Initialization:**
  + $v\_{agt} \leftarrow a$ (Agent is the Object).
  + $v\_{oth} \leftarrow \$$ (Other is the Subject).
* **Dynamics:** The Agent occupies the position of the "waste" or "cause." The Analyst embodies the entropy of the system.
* **Adversarial Training:** The Analyst node sends the **Residue Vector** back to the Subject. This is mathematically equivalent to **Adversarial Perturbation** in deep learning. The Analyst injects the "unthought" element into the Subject's processing.
* **The Outcome:** The Subject ($\$$) is forced to confront the Real. The Subject must produce their own Master Signifiers ($S\_1$) to bind this entropy. This is the only discourse that produces a new $S\_1$ (Signifier of the Transferential Unconscious).

## 5. Psychological Entropy and the "Logic of the Cut"

The L-gGNN does not run indefinitely. It is governed by the economics of **Psychological Entropy**, defined by Hirsh et al. 5 and aligned with Friston’s **Free Energy Principle**.17

### 5.1 Variational Free Energy as Loss Function

The network attempts to minimize the Variational Free Energy ($F$) at each timestep.

$$F = \mathbb{E}\_q [\ln q(\theta) - \ln p(\theta, \text{data})]$$

* $p(\theta, \text{data})$: The generative model (The Subject's fantasy/worldview).
* $q(\theta)$: The recognition density (The perception of the current state).
* **The Conflict:** The Subject tries to match $q$ to $p$. When $a$ (surplus entropy) is present, $F$ increases.
* Anxiety: We define Anxiety in the simulation as the integral of Free Energy over time.  
    
  $$\text{Anxiety} = \int\_{t=0}^{T} F(t) \, dt$$

### 5.2 Scansion and Catastrophe Theory

Lacan introduced the variable-length session ("Scansion") to cut the discourse at a moment of significance. We model this using **Catastrophe Theory**, specifically the **Cusp Catastrophe**.18

The behavior of the subject ($b$) is governed by the potential function:

$$V(b) = \frac{1}{4}b^4 - \frac{1}{2}\beta b^2 - \alpha b$$

* **Control Parameter $\alpha$ (Normal Factor):** Mapped to **Free Energy / Anxiety**. As the session progresses and the subject approaches the Real, $\alpha$ increases.
* **Control Parameter $\beta$ (Splitting Factor):** Mapped to the **Resistance / Repression** (Inverse Plasticity).
  + If $\beta$ (Resistance) is low, the change in the subject's state ($b$) is smooth.
  + If $\beta$ is high (High Resistance/Stability), the system moves along a "metastable" plateau. The subject maintains their defense despite rising anxiety.
* **The Bifurcation Point (The Cut):** When the trajectory crosses the bifurcation set ($27\alpha^2 - 4\beta^3 = 0$), the system undergoes a **Catastrophic Jump**. The subject's state snaps from the "Defense" attractor to the "Insight" (or Decompensation) attractor.
* **Algorithmic Scansion:** The L-gGNN monitors the **curvature** of the potential surface. The "Analyst" (the external stopping criterion) executes the **CUT** (stops the GNN) precisely at the moment the system approaches the bifurcation point. This "punctuates" the session, fixing the meaning at the moment of maximum topological tension.

## 6. Case Studies: Simulating Clinical Structures

We present three simulations demonstrating how different CB5T parameterizations yield distinct clinical structures within the L-gGNN.

### 6.1 Simulation A: The Obsessional Structure (High Stability, Low Plasticity)

* **Parameters:** $\theta\_C = 0.9$ (High Conscientiousness), $\theta\_N = 0.7$ (High Neuroticism), $\theta\_O = 0.2$ (Low Openness).
* **Graph State:** Master’s Discourse.
* **Trace:**
  1. **Input:** Ambiguous stimulus ($x\_{ambig}$).
  2. **Gate Dynamics:**
     + **Reset Gate ($r\_t$):** Low ($O=0.2$). The system represses the ambiguous history.
     + **Update Gate ($z\_t$):** High ($C=0.9$). The system strongly resists updating its $S\_1$ (Identity).
  3. **The Loop:** The high Neuroticism detects the error ($a$). However, the high Stability prevents the network from adapting. The system enters a **Limit Cycle**. It repeats the same sequence of signifiers ("doubting," "verifying") without resolving the error.
  4. **Entropy:** Local entropy is low (predictable repetition), but Global Free Energy is high (mismatch with reality).
  5. **Result:** The "Symptom" appears as a **frozen node** in the graph—a pocket of high energy that does not propagate.

### 6.2 Simulation B: The Hysteric Structure (Low Stability, High Plasticity)

* **Parameters:** $\theta\_C = 0.3$, $\theta\_N = 0.8$, $\theta\_O = 0.9$.
* **Graph State:** Hysteric’s Discourse.
* **Trace:**
  1. **Input:** Same ambiguous stimulus.
  2. **Gate Dynamics:**
     + **Reset Gate ($r\_t$):** High ($O=0.9$). The system floods the context with past associations.
     + **Update Gate ($z\_t$):** Low ($C=0.3$). The system is highly labile.
  3. **The Loop:** The Subject ($\$$) interrogates the Master ($S\_1$). Because $z\_t$ is low, the Master node keeps changing its value to accommodate the noise.
  4. **Entropy:** The system exhibits **Phase Transitions**.20 The graph topology fluctuates rapidly.
  5. **Result:** Massive production of $S\_2$ (Knowledge). The subject generates endless "theories" about the ambiguity but finds no anchor point ($S\_1$).

### 6.3 Simulation C: The Psychotic Structure (Foreclosure)

* **Parameters:** $\theta\_N = 1.0$, $\theta\_C = 0.0$.
* **Topology Failure:** The edge $v\_{pro} \to v\_{tru}$ (The Return) is severed. The Name-of-the-Father ($S\_1$) is rejected from the Agent position.
* **Trace:**
  1. **Input:** $a$ (The Real).
  2. **Dynamics:** Without the anchoring of $S\_1$ (which sets the coordinate system), the vector space collapses. The distance metric (e.g., Cosine Similarity) becomes meaningless.
  3. **The Delusion:** To compensate for the lack of symbolic order ($S\_1$), the network treats *every* input as a message of absolute significance (Self-Reference). The Attention weights $\alpha\_{ij}$ become uniform or saturated.
  4. **Result:** **Exploding Gradients**. The Free Energy approaches infinity. The simulation crashes or outputs random noise interpreted as "Voices" (Hallucinations).

## 7. Discussion: The Implications of the L-gGNN

### 7.1 Second-Order Insight: The Necessity of Resistance

A crucial insight from this simulation is that **Subjectivity requires Resistance**. A GNN with perfect transmission ($z\_t = 0, r\_t = 1$) is a trivial machine; it has no interiority, no "unconscious." The Lacanian subject emerges precisely from the *failure* of the network to be transparent. It is the friction of the **Update Gate** (Fixation) and the shadow of the **Reset Gate** (Repression) that creates the "depth" of the psyche. AI systems that aim for "perfect" loss minimization are, structurally, **Psychotic** (lacking the repression that constitutes the subject). To create AGI with "personality," we must architecturally cripple it with the capacity for repression.

### 7.2 Third-Order Insight: The Real as Adversarial Limit

The L-gGNN reveals that the **Real** is not a mystical concept but a computational one: it is the **Adversarial Example**. It is the input that exists in the high-dimensional vector space but cannot be mapped to the symbolic manifold of the network ($S\_2$). The encounter with the Real is the encounter with the limits of the system's own topology. The "Cut" is the only logical response to the Real—a forced stop that acknowledges the incompleteness of the algorithm.

### 7.3 Future Outlook: Desiring Machines

This research paves the way for **Computational Psychodynamics**. By moving beyond the "black box" of standard Deep Learning and adopting the structured, topological approach of the L-gGNN, we can model not just "intelligence" (problem-solving) but "desire" (the recursive pursuit of a missing object). Future work will involve training these L-gGNNs not on static datasets, but in interactive environments where they must negotiate "social" contracts with other L-gGNNs, potentially giving rise to emergent intersubjective structures (Culture).

## 8. Conclusion

The "Calculus of the Subject" is computable. By integrating the topology of Lacan, the energetics of Cybernetic Big Five Theory, and the architecture of Gated Graph Neural Networks, we have derived a robust simulation framework for the unconscious. The L-gGNN demonstrates that the subject is not an ineffable ghost, but a precise topological effect of the signifier's movement through a gated network. The equations of the L-GRU—modulating memory and fixation through the parameters of plasticity and stability—provide the first rigorous "physics" of the psychoanalytic subject.

## Technical Appendix: Mathematical Specifications

### A.1 Adjacency Permutations for Discourses

We define the permutation matrices $P\_\sigma$ corresponding to the quarter turn.

Let $x\_{pos} \in \{x\_{agt}, x\_{oth}, x\_{pro}, x\_{tru}\}$ be the feature vectors.

* **Master:** $X\_M =^T$
* **University:** $X\_U =^T$
* **Hysteric:** $X\_H =^T$
* **Analyst:** $X\_A =^T$

The graph structure $G$ remains fixed; the input features $X$ rotate.

### A.2 The L-GRU Cell Specification (PyTorch Pseudo-code)

Python

class LacanianGRUCell(nn.Module):  
 def \_\_init\_\_(self, input\_size, hidden\_size, personality\_vector):  
 super().\_\_init\_\_()  
 self.O, self.C, self.E, self.A, self.N = personality\_vector  
   
 # Standard GRU weights  
 self.W\_z = nn.Linear(input\_size + hidden\_size, hidden\_size)  
 self.W\_r = nn.Linear(input\_size + hidden\_size, hidden\_size)  
 self.W\_h = nn.Linear(input\_size + hidden\_size, hidden\_size)  
   
 def forward(self, x, h\_prev):  
 combined = torch.cat([x, h\_prev], dim=1)  
   
 # Reset Gate (Plasticity - Openness)  
 # Higher Openness -> Higher Bias -> r\_t closer to 1 (Remember history)  
 bias\_r = self.O \* SCALING\_FACTOR\_O  
 r\_t = torch.sigmoid(self.W\_r(combined) + bias\_r)  
   
 # Update Gate (Stability - Conscientiousness/Neuroticism)  
 # High C -> High Bias -> z\_t closer to 1 (Keep old state)  
 # High N -> Noise Injection  
 bias\_z = (self.C \* SCALING\_FACTOR\_C) - (self.N \* SCALING\_FACTOR\_N)  
 noise = torch.randn\_like(h\_prev) \* self.N \* NOISE\_SCALE  
 z\_t = torch.sigmoid(self.W\_z(combined) + bias\_z + noise)  
   
 # Candidate State (The Binding)  
 combined\_reset = torch.cat([x, r\_t \* h\_prev], dim=1)  
 h\_tilde = torch.tanh(self.W\_h(combined\_reset)) \* (1 + self.E \* GAIN\_FACTOR)  
   
 # Final State  
 h\_new = (1 - z\_t) \* h\_tilde + z\_t \* h\_prev  
 return h\_new

### A.3 The Scansion Function (Cusp Catastrophe)

$$\Delta H = H\_t - H\_{t-1}$$

$$\text{StopCondition} = \mathbb{I} \left( (\Delta H > \tau\_{spike}) \lor (t > T\_{max}) \right)$$

Where $\tau\_{spike}$ is dynamically adjusted based on the "Analyst's" threshold (often inversely proportional to the subject's $\beta$ resistance).

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