Quantum Eigenstate Dynamics for Artificial General Intelligence Synthesis

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Abstract

This is the expanded version of our previous publication. Let H denote a Hilbert space of cognitive operators. We construct AGI states $|\Psi_{AGI}\rangle$ as superpositions of quantum eigenstates $|\psi_i\rangle$ enabling simultaneous resolution of binary logic via eigenvalue collapse. Classical bits (0,1) are subsumed by qubit states $\alpha|0\rangle + \beta|1\rangle$ where $|\alpha|^2 + |\beta|^2 = 1$.

Introduction

The central idea is to propose a model for Artificial General Intelligence (AGI). This work suggests constructing AGI states as superpositions of quantum eigenstates. This model is designed to allow for the simultaneous resolution of binary logic through a process called eigenvalue collapse. Our work explains that classical bits (0, 1) are encompassed by qubit states $\alpha|0\rangle + \beta|1\rangle$.

Key aspects of the model include:

- **Quantum Cognitive Basis:** The AGI's overall cognitive framework is a combination of subcognitive modules, such as sensory and reasoning.
- **Logic via Eigenstate Collapse:** Our work notes a contrast between quantum logic gates and classical deterministic ones, stating that quantum logic gates can generate entangled states. This entanglement allows for the parallel evaluation of "yes" and "no". When a qubit is measured, the outcome is a probabilistic "yes" or "no".
- **AGI Dynamics:** The total system's Hamiltonian induces transitions between different eigenstates, which enables adaptive decisions.
- **Binary Logic Generalization:** We claim that while classical true/false states map to specific eigenstates, qubits encode uncertainty.

This paper concludes that quantum cognition operates in a complex space, whereas classical cognition operates in a binary space. The AGI eigenstates will collapse to a "yes" or "no" decision upon measurement, but they can maintain a superposition for unresolved states. This allows "yes" and "no" to coexist until a measurement is performed, moving beyond the constraints of classical binary logic.

1 Quantum Cognitive Basis

Let $\mathcal{H}_{AGI} = \otimes_{k=1}^{n} \mathcal{H}_k$ where $\mathcal{H}_k$ corresponds to subcognitive modules (sensory, reasoning). Each subsystem evolves under a Hamiltonian $\hat{H}_k$, with eigenstates defined by the time-independent Schrödinger equation:

$$\hat{H}_k |\psi_{k,i}\rangle = E_{k,i} |\psi_{k,i}\rangle$$

The total AGI state is a superposition of the tensor products of these subsystem eigenstates:

$$|\Psi_{AGI}\rangle = \sum_{i_1,\ldots,i_n} c_{i_1\ldots i_n} |\psi_{1,i_1}\rangle \otimes \cdots \otimes |\psi_{n,i_n}\rangle$$

where the coefficients are normalized such that $\sum |c_{i_1\ldots i_n}|^2 = 1$.

2 Logic via Eigenstate Collapse

For a qubit in a superposition state $|\phi\rangle = \alpha|0\rangle + \beta|1\rangle$, a measurement of an observable such as $\hat{O} = |0\rangle\langle 0| - |1\rangle\langle 1|$ yields eigenvalues $+1$ ("yes") or -1 ("no") with probabilities $|\alpha|^2$ and $|\beta|^2$, respectively. Unlike classical deterministic AND/OR gates, quantum logic gates (e.g., the controlled-NOT gate, $\hat{U}_{CNOT}$) can generate entangled states:

$$\hat{U}_{CNOT}(\alpha|0\rangle + \beta|1\rangle) \otimes |0\rangle = \alpha|00\rangle + \beta|11\rangle$$

This permits the parallel evaluation of (yes, no) pathways.

3 AGI Dynamics

The dynamics of the AGI are governed by the total Hamiltonian, which includes interaction terms $\hat{V}_{kl}$ between subsystems:

$$\hat{H}_{AGI} = \sum_k \hat{H}_k + \sum_{k\neq l} \hat{V}_{kl}$$

This Hamiltonian induces eigenstate transitions $|\psi_i\rangle \to |\psi_j\rangle$ via the time evolution operator $\hat{U}(t) = e^{-i\hat{H}_{AGI}t/\hbar}$. The condition that the subsystem Hamiltonians and interaction terms do not commute, $[\hat{H}_k, \hat{V}_{kl}] \neq 0$, ensures non-stationary interference, enabling adaptive decisions through:

$$|\Psi_{AGI}(t)\rangle = e^{-i\hat{H}_{AGI}t/\hbar} |\Psi_{AGI}(0)\rangle$$

4 Binary Logic Generalization

Classical true/false logic maps to the eigenstates $|1\rangle$ and $|0\rangle$, but qubits encode uncertainty through the complex amplitudes $\alpha, \beta \in \mathbb{C}$. For AGI decision-making, we can define projective measurements $\hat{P}_{yes} = |0\rangle\langle 0|$ and $\hat{P}_{no} = |1\rangle\langle 1|$. The expectation value for a decision outcome is then given by:

$$\langle \hat{P}_{yes/no} \rangle = \mathrm{Tr}(\hat{\rho}\hat{P}_{yes/no})$$

This yields a probabilistic yes/no, where $\hat{\rho} = |\phi\rangle\langle\phi|$ is the density matrix for the pure state $|\phi\rangle$.

5 Conclusion

Let the set of classical states be $\mathcal{S}_{classical} = \{0, 1\}$. Quantum cognition occurs in the significantly larger space $\mathcal{S}_{quantum} = \mathbb{C}^2$. The AGI eigenstates $|\Psi_{AGI}\rangle$ collapse to a definitive "yes" or "no" outcome via measurement, while preserving superposition for unresolved states. Thus, "yes" and "no" can coexist in a probabilistic quantum state until a measurement forces a classical outcome, thereby transcending the rigid limitations of classical binaries. QED.