Superposition Futarchy: Conditional Execution via Market-Based State Collapse

Greshams Code[1]

[1]Founder, Govex.ai

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Abstract

We present a novel form of futarchy where conditional outcomes exist in superposition until resolved by market consensus. Upon initiation of a futarchy proposal all proposed token actions are minted and performed immediately with conditional tokens. These tokens trade freely until being resolved by a market-based uncertainty metric $\Delta P \times \Delta R$ falls below a threshold k, triggering deterministic "collapse" to a single outcome. If uncertainty remains high at deadline, probabilistic resolution based on market prices prevents indefinite lockup. The protocol operates on a state budget rather than limiting concurrent events, allowing flexible combinations (e.g., the Cartesian product of 4 binary events or one 16-outcome event within a 16-state budget). Events can be entangled via logical dependencies, enabling complex conditional structures.

1 Immediate Conditional Token Creation

- Current implementations of futarchy allow users to create proposals for the futarchy treasury to transfer spot tokens to an address. Assuming the proposal measuring period is X seconds. This creates X seconds latency between decision proposal and decision actions. This has an opportunity cost of VALUE-TO-TRANSFER*X*MARKET-INTEREST-RATE.
- Mint all outcome tokens instantly: approved-X and rejected-X
- Tokens trade freely until resolution
- No waiting period, immediate capital utility
- Useful abstraction that allows futarchy treasury to atomically buy back or dilute its own stock when it is trades below or above net asset value, without being front run.

2 Quantum states budget

- using carteasian product of all verses and their partitions
- State expansion
- State colapse
- Superposition: multiple states exist simultaneously
- States collapse as proposals resolve
- New proposals enter freed slots
- Continuous pipeline of decisions
- Liquidity preservation across transitions

- Efficient encoding of valid states
- Pruning impossible combinations
- Lazy evaluation of state transitions
- Memory-efficient representation
- https://a16zcrypto.com/posts/videos/multidimensional-tfm-design/ optimization

3 The Uncertainty Measurement: $\Delta P \times \Delta R$ Formalization

- ΔP: price volatility (bid-ask spread or standard deviation)
- ΔR: rate of price reversals (flip frequency)
- Threshold k: market-specific constant
- Analogous to Heisenberg uncertainty principle
- Progressive Resolution Thresholds
- Early phase: requires very low $\Delta P \times \Delta R$
- Threshold relaxes as deadline approaches
- Prevents premature resolution
- Ensures eventual resolution
- When $\Delta P \times \Delta R < k$: market consensus achieved
- Deterministic outcome based on market prices
- All non-winning tokens $\to 0$

4 Dynamic Resolution Ordering

- Proposals with lowest $\Delta P \times \Delta R$ resolve first
- Queue dynamically reorders as market conditions change
- Creates natural prioritization of clear decisions
- Resolution racing incentives

5 Quantum Measurement: Probabilistic Fallback

- If deadline reached with high uncertainty
- Sample outcome probabilistically from market distribution
- Prevents griefing attacks
- Maintains incentive compatibility

6 Logical Gates for Conditional Events

- AND/OR/NOT/XOR relationships between proposals
- Automatic cascading when parent resolves
- Dependency DAG construction
- Prevents inconsistent states

7 Cascading Resolution Mechanics

- Parent resolution triggers child collapses
- Automatic execution of dependent actions
- No manual intervention required

8 Entangled Order Types

- Entanglement: correlated proposals via logic gates
- Cross-market conditional execution
- Spread trading between correlated proposals
- Automatic arbitrage for maintaining correlations
- Natural price discovery for dependencies

References