iQuCodeFest - Quantum Board Games

Exploring the use of quantum computing in
redesigning popular board games

Quantum AlgoLab

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1 Context

Board games meet quantum mechanics! This hackaton invites you to redesign classic games by integrating core quantum information concepts—such as superposition, entanglement, and measurement—into their mechanics. Over the course of the hackathon, you will collaborate, prototype, and experiment to create innovative gameplay experiences and explore new possibilities. This is an opportunity to rethink how games work.

How might quantum uncertainty redefine resource gathering in Catan? Could superposition create new strategic opportunities in Carcassonne? What happens when information is entangled in Exploding Kittens? How could quantum effects enhance Earth's ecosystem-building mechanics? And so on and so forth.

2 Rules

2.1 General workflow

2.1.1 Step 1: Select a Game

Choose a game to redesign. For example, you can pick one of the following games:

- **Carcassonne** (Placement)
- **Exploding Kittens** (Party / Social Deduction)
- **Monopoly** (Real Estate)

You must have a mentor approve your choice of game by the end of the first day.

2.1.2 Step 2: Breakdown of Game Mechanics

For the game you have selected, break it down into a set of key mechanics. These mechanics are the fundamental actions, components, or systems that drive gameplay. For example, in *Catan*, mechanics might include resource generation, trading, road building, and development cards. Describe each of these mechanics clearly.

2.1.3 Step 3: Quantum Integration

For as many mechanics as you'd like, create a *quantumized* version. Think about how quantum information principles such as superposition, entanglement, and quantum measurement can transform or add depth to each mechanic. The goal is to creatively redesign the game with the following quantum concepts in mind:

- **Superposition**: Allow certain decisions, actions, or outcomes to exist in multiple states simultaneously, only resolving when a specific condition (such as a "measurement") occurs.
- **Entanglement**: Create interactions between players or components of the game that are entangled, meaning that the state of one part of the game affects another, even over distance.
- **Quantum Randomness**: Incorporate elements of probabilistic or non-deterministic outcomes that reflect quantum randomness, rather than traditional randomness (e.g., dice rolls).
- **Quantum Measurement**: Introduce a mechanic where certain actions or outcomes are "measured," collapsing multiple possibilities into one.

2.1.4 Step 4: Prototype in Python

Once you've identified and reimagined the quantum mechanics of your game, create a prototype in Python. Your prototype should model the key quantum aspects of the game mechanics you have redesigned. This prototype will allow you to simulate and test your new rules and explore how the quantum mechanics influence gameplay.

3 Submission Requirements

A presentation outlining the game mechanics and the quantum-inspired redesigns you have proposed. Your presentation should clearly showcase how you thought about the game from end to end, as well as the judging criteria.

A Python prototype that demonstrates your redesigned mechanics.

3.0.1 Judging Criteria

Your submissions will be judged based on the following:

- **Creativity**: How creatively you've integrated quantum concepts into the game mechanics.
- **Feasibility**: How well the quantum-inspired mechanics fit into the structure of the game.
- **Playability** : Is the game playable from end to end.
- **Technical Implementation**: How well the Python prototype demonstrates the quantum mechanics in practice.
- **Clarity**: How clearly you communicate your redesign and prototype.
- Bonus - **Artistic Direction**: Any artistic design of the quantum-enhanced game.

4 Example - Snakes and Ladders

This is a simplified example of the redesign of Snakes and Ladders.

Objective : Reinvent the classic game *Snakes and Ladders* using principles of quantum computing—while keeping it playable, fun, and strategic.

4.1 Core Mechanics – Quantum Redesign

Take the basic structure of Snakes and Ladders and reimagine it through quantum mechanics. The goal is to transform its core elements to create a new game dynamic that introduces quantum phenomena like superposition, entanglement, and measurement.

4.1.1 Quantum Roll – Superposition Move

- On each turn, instead of a single die result, the player enters a *superposition* of two positions (e.g., 3 **and** 5).
- These positions exist simultaneously until the next turn, when a *measurement* collapses the state to determine the actual position.
- Players can use **Quantum Tokens** to bias or delay the collapse.

4.1.2 Entangled Snakes – Shared Penalties

- Certain "quantum snakes" *entangle* two players.
- If one lands on the snake, both entangled players suffer the penalty.

4.1.3 Quantum Ladders – Probabilistic Boosts

- Ladders no longer guarantee boosts. Instead, they simulate *quantum tunneling*.
- Landing at a ladder base gives a chance to move ahead, resolved by a **quantum test** (e.g., coin flip, card draw, or noisy qubit sim).
- Some ladders lead to multiple potential destinations, with measurement resolving the final location.

4.1.4 Additional Elements

- Decoherence Squares: Collapse any superposition immediately when landed on.
- Quantum Action Cards: Apply quantum gates (Hadamard = split path, Pauli-X = move reversal, SWAP = exchange position with another player).
- Quantum Tokens: Earned through play; spent to influence outcomes or break entanglement.

4.2 Winning Conditions

Be the first player to land *exactly* on the final square, with your state collapsed. Superpositions beyond the goal do not count until measured.