Quantum Map Generator Hackathon
Quantum Machine Learning Track
Online Technical Competition
Ingenium — IIT Indore

Competition Overview

Quantum computing and Quantum Machine Learning (QML) are rapidly emerging as important paradigms in both academic research and industry. However, most student-level engagements remain limited to guided tutorials or narrowly defined problems.

This competition introduces participants to a research-inspired, open-ended QML challenge that focuses on **quantum generative modeling**. By combining quantum circuits, probabilistic measurement outcomes, and classical post-processing, participants will explore novel approaches to procedural map generation used in games, simulations, and visualization systems.

Problem Statement

Participants are tasked with designing and implementing a **Quantum Map Generator** that produces two-dimensional maps using quantum circuits and measurement statistics.

The challenge emphasizes translating theoretical quantum concepts such as superposition, probability, and measurement into a complete, end-to-end generative pipeline.

The objective is not to reproduce a fixed solution, but to creatively explore quantum procedural content generation through circuit design, encoding strategies, and visualization techniques.

Information Provided to Participants

Participants will be introduced to the problem through:

- A high-level overview of the research paper *"A Quantum Procedure for Map Generation"*

- Definition of the input–output pipeline, where quantum circuits generate measurement outcomes that are post-processed into 2D maps

- Example visualizations illustrating probabilistic-to-spatial interpretation

- Clearly defined constraints and objectives, with open-ended design freedom

The focus will be on understanding the formulation of the problem rather than replicating a specific implementation.

Competition Task

Participants must build an end-to-end Quantum Map Generation pipeline consisting of:

1. **Circuit Design:** Design quantum circuits where qubit connectivity and state preparation encode spatial or territorial information

2. **Measurement:** Execute circuits to obtain probabilistic measurement outcomes

3. **Classical Post-Processing:** Map quantum measurement statistics to a classical 2D grid to generate coherent map structures

The competition explores Quantum Procedural Content Generation (PCG) as a creative application of quantum algorithms.

Research Basis

This competition is inspired by the research paper:

- A. Pérez-Salinas et al., *"A Quantum Procedure for Map Generation"*

Participants are encouraged to innovate beyond the baseline approach presented in the paper by experimenting with alternative encodings and mapping strategies.

Competition Structure

The competition follows a phased online hackathon format:

- **Phase 1:** Registration and problem statement release

- **Phase 2:** Development and implementation

- **Phase 3:** Final submission and evaluation

The total duration of the competition will be between 24 and 48 hours.

Technical Requirements

- Implementation using quantum simulation frameworks such as Qiskit

- Use of Python and relevant scientific or visualization libraries

- Stable internet connectivity for the online hackathon

Evaluation Criteria

Submissions will be evaluated based on:

- **Technical Depth:** Understanding of quantum encoding and circuit design

- **Visualization Quality:** Clarity and structure of the generated 2D maps

- **Innovation:** Creativity in extending or reinterpreting the quantum procedure

- **Explanation:** Clarity in describing the approach and design choices

Expected Outcomes

- Skill development in quantum computing and generative modeling

- Exposure to interdisciplinary applications of quantum algorithms

- Increased engagement with research-driven problem solving

- Sustained interest in advanced computational research

Rules are subject to change at the discretion of the organisers.

Further instructions will be communicated to registered participants.