World Academy of Science, Engineering and Technology
International Journal of Nuclear and Quantum Engineering
Vol:18, No:06, 2024

Reinforcement Learning the Born Rule from Photon Detection

Authors : Rodrigo S. Piera, Jailson Sales Ara´ujo, Gabriela B. Lemos, Matthew B. Weiss, John B. DeBrota, Gabriel H. Aguilar, Jacques L. Pienaar

Abstract : The Born rule was historically viewed as an independent axiom of quantum mechanics until Gleason derived it in 1957 by assuming the Hilbert space structure of quantum measurements [1]. In subsequent decades there have been diverse proposals to derive the Born rule starting from even more basic assumptions [2]. In this work, we demonstrate that a simple reinforcement-learning algorithm, having no pre-programmed assumptions about quantum theory, will nevertheless converge to a behaviour pattern that accords with the Born rule, when tasked with predicting the output of a quantum optical implementation of a symmetric informationally-complete measurement (SIC). Our findings support a hypothesis due to QBism (the subjective Bayesian approach to quantum theory), which states that the Born rule can be thought of as a normative rule for making decisions in a quantum world [3].

Keywords : quantum Bayesianism, quantum theory, quantum information, quantum measurement
Conference Title : ICQIT 2024 : International Conference on Quantum Information Theory
Conference Location : Barcelona, Spain
Conference Dates : June 13-14, 2024