Contribution ID: **173** Type: **not specified**

Human-in-the-loop Reinforcement Learning for Data Quality Monitoring in Particle Physics Experiments

Wednesday 19 June 2024 16:23 (12 minutes)

Data Quality Monitoring (DQM) is a crucial task in large particle physics experiments, since detector malfunctioning can compromise the data. DQM is currently performed by human shifters, which is costly and results in limited accuracy. In this work, we provide a proof-of-concept for applying human-in-the-loop Reinforcement Learning (RL) to automate the DQM process while adapting to operating conditions that change over time. We implement a prototype based on the Proximal Policy Optimization (PPO) algorithm and validate it on a simplified synthetic dataset. We demonstrate how a multi-agent system can be trained for continuous automated monitoring during data collection, with human intervention actively requested only when relevant. We show that random, unbiased noise in human classification can be reduced, leading to an improved accuracy over the baseline. Additionally, we propose data augmentation techniques to deal with scarce data and to accelerate the learning process. Finally, our studies can be found in arXiv by the following link: https://arxiv.org/abs/2405.15508.

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Session Classification: ML Workshop