Abstract

My work focuses on the implementation and evaluation of the *Double Deep Q-network for Sensing and Access (DDQSA)* algorithm, as proposed in the paper *"Deep Reinforcement Learning for Simultaneous Sensing and Channel Access in Cognitive Networks"*. The problem addressed involves dynamic spectrum access (DSA) in cognitive radio networks, where secondary users (SUs) opportunistically access frequency channels without disrupting the operations of licensed primary users (PUs). Unlike prior approaches that either assume fully observable environments or fix the sensing policy in advance, this work targets the more realistic scenario where the SU can only sense a limited subset of channels (narrowband sensing), leading to partial observability. The DDQSA framework tackles this challenge by jointly learning optimal sensing and access strategies using deep reinforcement learning in a partially observable Markov decision process (POMDP) setting. I have implemented the DDQSA algorithm in Python, replicated the key simulation environments from the paper, and validated the throughput performance gains. The results confirm that DDQSA significantly outperforms traditional approaches, including policies based on myopic selection, Whittle index heuristics, or deterministic sensing, particularly in environments where PUs exhibit stochastic and bursty activity governed by unknown Markovian traffic patterns..

As a next step, our research proposes the integration of Large Language Models (LLMs) into the DDQSA framework to enhance decision-making and system interpretability. LLMs can act as high-level controllers or policy-guidance agents, providing context-aware adjustments to hyperparameters, tuning exploration strategies, or even interpreting environmental feedback for better convergence. We aim to leverage the reasoning capabilities of LLMs to dynamically adapt the DDQSA agent’s behavior in multi-user or non-stationary environments, offering a novel direction toward more intelligent, explainable, and robust cognitive radio systems.