Machine Training using Reinforcement Learning (Q■Learning & DQN)

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1. Introduction

This project focuses on training a machine using Reinforcement Learning techniques. Both Q■Learning and Deep Q■Network (DQN) methods are implemented to train an agent to clean a simulated environment using rewards and interactions.

2. Project Objective

• Train an intelligent agent using RL
• Use dataset■based machine state inputs
• Compare Q■Learning and DQN performance
• Visualize learning using simulation and graphs

3. Dataset Used

A dataset consisting of multiple 5×5 grid states was generated. Each grid contains clean (0) and dirty (1) spots. Each grid represents one episode for training the RL agent.

4. Simulation Environment

A custom grid■world environment was built. The agent can move in four directions and receives +10 reward when it cleans a dirty spot. The environment ends when all dirt is cleaned.

5. Q■Learning Approach

• Q■table based method
• Uses Bellman equation for updates
• Epsilon■greedy exploration strategy
• Suitable for small environments

6. Deep Q■Network (DQN) Approach

• Neural network predicts Q■values
• Uses replay memory and stochastic sampling
• More stable and scalable than Q■Learning
• Performs better with complex states

7. Comparison of Both Methods

Q■Learning is simpler but limited. DQN learns faster, handles more complex input, and gives higher rewards. Reward vs episode graphs show that DQN converges faster.

8. Results & Graphs

• Reward curves
• Smoothed performance trends
• Q■table heatmaps
• Episode step analysis

9. Conclusion

The agent successfully learned to clean the environment. DQN outperformed Q■Learning due to better generalization. Dataset variation helped the agent learn more robustly.

10. References

• Reinforcement Learning — Sutton & Barto
• OpenAI Gym concepts
• DeepMind DQN research papers