MACHINE LEARNING

UE23CS352A: Machine Learning Hackathon

5th Semester, Academic Year 2024-25

TEAM_ID : 10

Team details :-

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Analysis Report – Hackman

1. Key Observations

- 5 Major Challenges: Sparse rewards, exploration-exploitation balance, state space complexity, mocked neural network, bigram limitations
- 5 Critical Insights: HMM feature extraction impact, reward shaping importance, training duration necessity, clean data validation, mandate formula alignment

2 . Strategies:

- HMM Design Choices: Why bigrams, Laplace smoothing formula, feature extraction methodology

- RL State Representation: 4-component concatenated state (mask binary, guessed letters, HMM vector, scalar features) with detailed reasoning
- Reward Structure: Complete breakdown of all rewards (-2 repeated, +5 correct, -5 wrong, -30 loss, +2000 win) mapped to mandate formula

3 . Exploration:

- Three Training Phases: Exploration (0-30K), Transition (30-70K), Exploitation (70-100K)
- Epsilon Decay Formula: Mathematical explanation with empirical decay rates from your output
- Balancing Strategy: Why epsilon-greedy with decay outperforms pure exploration/exploitation

4. Future Improvements (8 Concrete Proposals)

- Implement actual Keras/TensorFlow neural network (+5-15% expected improvement)
- Higher-order n-gram models (+3-5% improvement)
- Double DQN for reduced overestimation (+2-3% improvement)
- Dueling DQN architecture (+2-3% improvement)
- Curriculum learning strategy (+4-6% improvement)
- Contextual embeddings for semantic patterns (+5-8% improvement)
- Prioritized experience replay (+3-5% improvement)
- Multi-task learning approach (+2-4% improvement)
- Each with implementation hints and expected impact analysis.

5 . Additional Sections

- Technical Architecture Overview: Data pipeline, HMM training flow, RL loop pseudocode
- Code Complexity Analysis: Time/space complexity table for each component
- Appendix: Empirical validation of 368.8s training time