Reinforcement Learning Project Proposal & Scoping

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I. PROBLEM STATEMENT

In traditional video games, enemies are usually designed with fixed difficulty levels (e.g., Easy, Medium, Hard); these levels often fail to match a player's skill level or sustain long-term engagement. As a result, players who find the game too easy quickly become bored, while those who find it too difficult become frustrated.

The paper "Go with the Flow: Reinforcement Learning in Turn-based Battle Video Games" (Pagalyte et al., 2020) addresses this issue by proposing a Reinforcement Learning (SARSA-based) system for Dynamic Difficulty Adjustment (DDA). The goal of the authors of this paper is to create an AI opponent that automatically learns to balance challenge and engagement during gameplay.

II. MOTIVATION

Dynamic Difficulty Adjustment (DDA) is a key step toward personalized and adaptive game design. The authors use DDA with the SARSA algorithm to achieve a system that adapts its difficulty in real time to maintain engagement and challenge balance. Using this approach also results in games with broader implications for adaptive tutoring systems and training simulators, and it can be extended to gamified learning platforms.

III. FEASIBILITY

Because the SARSA algorithm and state-reward structure are straightforward to implement in Python or Unity, the project requires only basic computational resources. The RL agent operates on a discrete state-action space with small-scale training data; hence, this project is computationally feasible without GPUs or large datasets.

Potential challenges that can arise during experiments, such as reward tuning or overuse of specific actions (e.g., Heal), can be managed through controlled simulation and logging.

IV. PREDICTED TIMELINE

The timeline for replicating this project can be split into 4 weeks, each week working towards a new milestone.

A. Week 1:
- Review the SARSA algorithm and design the simplified battle game structure (states, actions, rewards).

B. Week 2:
- Implement the baseline fixed-difficulty AIs (easy, medium, hard).
- Implement the RL (SARSA) adaptive agent.

C. Week 3:
- Train and test the agent through automated battles; log HP differences and outcomes.
- Analyze results (win/loss ratio, balance metrics, and simulated engagement measures), comparing against fixed AIs.

D. Week 4:
- Finalize the findings.
- Prepare visuals and summary report.
- Finalize slides for presentation and write-up.

V. DATASET AND EXPERIMENT PLAN

For replicating the experiment one-on-one, no external dataset is required. The game simulation generates its own data through repeated battles, which consist of in-game states, chosen actions, and received rewards. The engagement can be simulated using target HP differences or validated with limited real-player input.