

CS258 Final Project Proposal

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Project Title: Learning to Survive in a dual-objective environment

Introduction: We propose to design a lightweight 2D gridworld to study **Dual-Objective Reinforcement Learning**. In this environment, an agent must balance two competing goals: **Efficient Navigation** (reaching a designated goal) and **Resource Collection** (gathering reward items), while avoiding obstacles. Rather than optimizing for a single task, the agent must learn policies that find optimal trade-offs between these two distinct objectives.

Work Scope:

- **Simplified Environment Design:** To minimize development time, we will implement a basic 2D gridworld. The state space will use a compact representation encoding the agent's position relative to the goal, nearest items, and static obstacles.
- **Dual-Objective Formulation:** We will focus on the conflict between:
 - Task Completion: Reaching the goal position as quickly as possible.
 - Maximization: Deviating from the optimal path to collect reward items.
- **Reward Mechanism Investigation:** Addressing the challenges of dual-objective rewards, we will experiment with different scalarization techniques to combine these two terms, specifically comparing Linear Scalarization and Reward Scheduling.
- **Algorithm Implementation & Analysis:** We will adapt PPO (Proximal Policy Optimization) to this dual-objective setting. The core analysis will focus on how different reward combination schemes affect the agent's final policy and convergence speed.

Expected Outcomes We expect to demonstrate how different reward shaping techniques influence the agent's behavior—ranging from "greedy" collectors to "efficient" navigators. This project aims to provide hands-on insight into the stability of RL when facing conflicting reward signals, without the overhead of a complex simulation environment.