GAME BRAIN:
THE EVOLVING UNITY EXPERIENCE

Authors: Grant Fullenkamp, Noah Heinen, Roshan Krishnan
Advisor: Dr. Bayley King

AUTHORS


GRANT FULLENKAMP

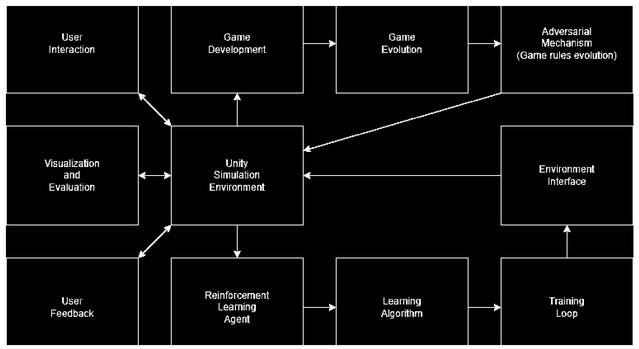

NOAH NEINEN


ROSHAN KRISHNAN

01. ABSTRACT

GameBrain is an innovative project that combines machine learning techniques with the Unity game engine to create a dynamic and evolving gaming experience. By leveraging machine learning (ML) agents, our project aims to develop intelligent game characters that learn and adapt to the game environment in real-time, while leveraging Large Language Models (LLM) to help in future game features and ML agent development.

02. DESIGN DIAGRAM



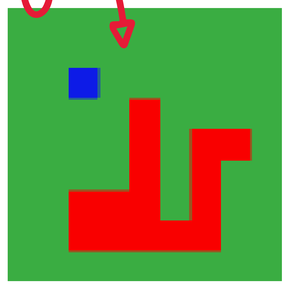
03. DEVELOPMENT PROCESS

1. Game Development in Unity:
   - Design and Implementation: Created the game in Unity, defining mechanics and aesthetics.
   - Iterative Refinement: Conducted iterative testing and refinement for optimal gameplay.
2. Reinforcement Learning (RL) Agent Integration:
   - ML Agents Integration: Integrated ML Agents into Unity for intelligent game characters.
   - Training Pipeline: Established a training pipeline for RL agent using reinforcement learning.
3. Utilization of Game Outputs with Large Language Model:
   - Output Analysis: Analyzed RL agent outputs to identify patterns and trends.
   - LLM Integration: Utilized LLM analysis for insights and further development.

04. RESULTS

1. RL Agent Training Success:
   - Achievement: Successfully trained an RL agent to achieve significant improvement in performance within a limited number of moves.
   - Specific Outcome: The RL agent went from achieving 1 food to 18 food within 100 moves of starting, demonstrating effective learning and adaptation capabilities.
2. Contribution of LLM:
   - RL Agent Suggestions: Utilized the LLM to analyze RL agent outputs and provide insights for enhancing training strategies. LLM suggestions were instrumental in refining reward structures, optimizing observation spaces, and improving agent performance.
   - Game Feature Suggestions: Leveraged LLM capabilities to generate suggestions for enhancing game features and mechanics. By analyzing player interactions and game outputs, LLM insights were used to identify areas for gameplay improvement, leading to the refinement of game mechanics and overall user experience.

These results underscore the effectiveness of RL agent training and the valuable contributions of LLM in providing actionable insights for both training optimization and game feature enhancement.



BEST INITIAL RL AGENT PERFORMANCE

BEST INITIAL RL AGENT METRICS

05. CHALLENGES

1. Time Management:
   - Challenge: Balancing project deadlines with RL integration complexity.
   - Improvement: Implemented efficient project management strategies.
2. Alignment of Game Mechanics and RL Objectives:
   - Challenge: Ensuring game mechanics align with RL objectives.
   - Improvement: Adjusted mechanics and rewards for optimal learning and performance.
3. Feedback Integration and Iterative Development:
   - Challenge: Incorporating RL feedback and iterative refinement.
   - Improvement: Implemented robust feedback mechanisms for continuous improvement from LLM generation..

06. CONCLUSION

GameBrain represents a pioneering approach to game development, introducing an evolving gaming experience tailored to each player's unique interactions and decisions. By harnessing the power of machine learning and AI, we aim to craft dynamic and personalized gaming adventures that adapt and evolve alongside the player. Through continuous innovation and collaboration, we strive to redefine the boundaries of interactive storytelling and gaming immersion.