COS435 / ECE433: Introduction to RL Due: March 24, 2024

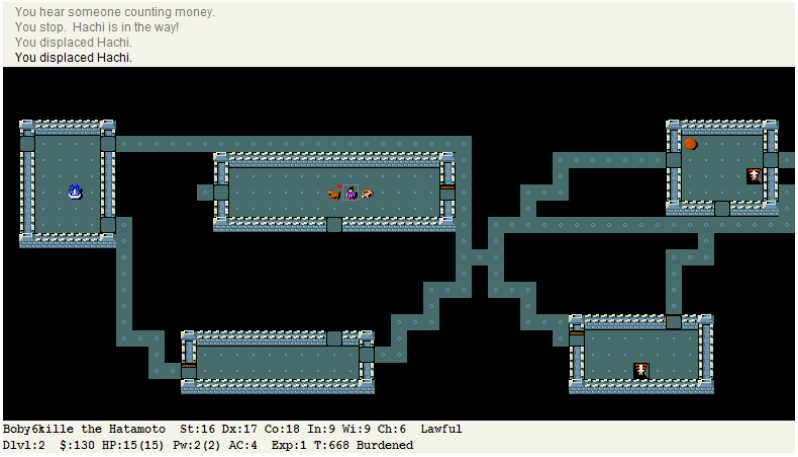
Project Proposal: Happy Go LuckyMera

Authors Eshaan Govil (eshaangovil@princeton.edu),
Arav Raval (ar3015@princeton.edu), Lynn Morris (lm7452@princeton.edu)

Project type 1. Reproducing a recent paper.

Description Our project is based on this recent paper[1], which proposes a configurable AI framework (LuckyMera) targeted to the game NetHack. NetHack is a single-player roguelike game where players engage in map exploration, enemy fights, and resource management. In sum, roguelike games are rooted in an inherent balance between exploration and exploitation, and LuckyMera enables the creation of hybrid agents capable of testing generalized game strategies. Hybrid agents combine features from various existing agent types, such as reactive, goal-based, or utility-based, to improve the overall decision-making within a complex environment. For example, an agent may react to immediate dangers (i.e. dangerous enemies), pursue a goal of overall level completion, and efficiently utilize its available resources, all within one environment/setting.

LuckyMera integrates *skills*, or symbolic and neural modules, which enables a mix of hard-coded strategy and reinforcement learning approaches. LuckyMera is also particularly effective in saving previous experiences or trajectories, and these retained datasets are utilized to train neural models. In the original paper, the authors validated LuckyMera's performance in line with state-of-the-art results, and the model is open-source, enabling a wide availability of learning methodologies.



(1)

NetHack gameplay in the terminal

Repository: Pervasive-AI-Lab

Workflow We plan to meet twice a week, 3 hours each time. Arav will prioritize setting up the environment and getting the libraries/packages to work together from the Github. Eshaan will focus on altering our algorithmic approach, with regards to rewards, loss functions, neural network architecture, etc. This will, of course, be a combined effort with all team members involved since everyone's knowledge from the course will be required. Lynn will lead data collection and analysis.

Challenges We expect to face a few challenges while recreating the experiments of this paper. These challenges include:

- **Environmental Setup:** recreating and setting up the initial NetHack environment is difficult and may pose early challenges
- **Environmental Representation:** NetHack is a complex game with a large state space, so recreating the framework will require a deep understanding of the game's various states / components, as well as their influence on the reward / value functions
- **Hybrid Agents:** this will be the first time we have approached a mixture of symbolic, rule-based AI and learning-based neural networks. Understanding how to blend both implementations together, as well as exhibit high performance in the complex NetHacks environment, may be a difficult endeavor that needs careful understanding of all incorporated architectures.

References

[1] Quarantiello, L., Marzeddu, S., Guzzi, A., and Lomonaco, V. (2023). Luckymera: a modular ai framework for building hybrid nethack agents.