

Project proposal:

Procedural text-based input recognition for classic text-based adventure games

This project aims to develop a natural language understanding system for text-based adventure games that can interpret varied player inputs without relying on predetermine commands. Traditional text adventures use rigid command structures, limiting player expressing and creating frustration when commands aren't recognized. This project will implement and compare two different methodologies for understanding player intent from natural language inputs.

The first system will use rule-based intent classification with word embeddings. This approach can leverage word embedding such as Word2Vec or GloVe to capture semantic similarity. Contextual clues and game states will be provided to enhance the embedding ability to interpret and understand intended actions and results. Pattern matching is combined with synonym recognition and semantic similarity, allowing the system to more flexibly handle a range of natural language expressions.

The second system will use transformer-based intent recognition. In this approach, a pre-trained BERT model is fine-tuned to classify player inputs into specific action categories. Named entity recognition is employed to identify referenced game objects, enhancing the system's ability to interpret commands.

This project is specifically distinct from game engines like Dungeon AI-which uses large LLMs to generate game states dynamically based on user input and story parameters. Instead, the system is intended to be applied to pre-written stories. Instead of generating the narrative, this classifier interprets player input and maps it to existing story elements, scenes, and scripted outcomes. The intent classification (whether rule-based or transformer-based) allows players to feel a part of the story and interact naturally with the game world while still having well-defined, developer-authored content.

The project will be evaluated by command recognition accuracy, flexibility, context resolution, and user experience. The comparative analysis will focus on which approach better handles linguistic variation, is more adaptable to novel phrasings, the trade-offs between accuracy and computational efficiency, and error pattern of each approach.

Bibliography:

Narasimhan, K., Kulkarni, T., & Barzilay, R. (2015). Language Understanding for Text-based Games Using Deep Reinforcement Learning: <https://arxiv.org/abs/1506.08941>

This paper presents a framework that combines deep reinforcement learning with natural language processing to address the language barrier in text-based games. Their approach focuses on learning state representations and action policies simultaneously using game rewards as feedback.

While my project focuses more on natural language understanding rather than reinforcement learning, Narasimhan's technique for mapping textual descriptions to vector representations provides a potential approach for handling varied player inputs while maintaining contextual understanding.

Ammanabrolu, P., & Riedl, M. O. (2019). Playing Text-Adventure Games with Graph-Based Deep Reinforcement Learning: <https://arxiv.org/abs/1812.01628>

This paper introduces an innovative approach to playing text-adventure games by representing the game state as a knowledge graph that is learned during gameplay exploration. Their system uses this graph to prune the action space, making exploration more efficient by eliminating impossible or irrelevant actions.

The action-pruning mechanism described in this paper offers a template for how valid actions in a given context could be determined while still allowing for natural language variation in how players express those actions.

Côté, M., et al. (2019). TextWorld: A Learning Environment for Text-based Games: <https://arxiv.org/abs/1806.11532>

TextWorld framework is a sandbox learning environment designed specifically for training and evaluating reinforcement learning agents on text-based games. The environment provides a testbed for NLP techniques in game environments, addressing challenges like combinatorial action spaces, partial observability, and commonsense reasoning.

TextWorld offers both a potential testing environment and conceptual insights into how procedural text games are structured. Their approach to defining game mechanics through a high-level description language could inform how constraints on player actions are structured.

Fulda, N., Ricks, D., Murdoch, B., & Wingate, D. (2017). What Can You Do With a Rock? Affordance Extraction via Word Embeddings: <https://arxiv.org/abs/1703.03429>

This paper explores the use of word embeddings to extract object affordances—actions that can be performed with objects—in text-based games. Fulda et al demonstrate how semantic relationships captured in pre-trained word embeddings can be leveraged to infer possible interactions with game objects without explicitly programming these relationships.

Using word embeddings to extract affordances is a potential mechanism to understand what actions are possible with given objects without requiring explicit programming of every possible interaction.

Urbanek, J., et al. (2019). Learning to Speak and Act in a Fantasy Text Adventure Game:
<https://arxiv.org/abs/1903.03094>

LIGHT is a large-scale fantasy text adventure game research platform designed for studying grounded dialogue. LIGHT features a dataset of game locations, characters, and objects with associated affordances, as well as natural language dialogue between characters.

Defining affordances for objects and characters offers a model for determining what actions are possible in a given game state. Also, their techniques for generalizing to new game scenarios could help my system handle novel player inputs that weren't explicitly outlined during development.