
Software Requirements Specification

for

Dungeon-Crawler IA

Version 1.0 approved

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1. Introduction

1.1 Purpose

The purpose of the Dungeon Crawler-AI project is to explore and understand the principles and mechanisms of artificial intelligence, specifically in the field of reinforcement learning. The project features a character with a defined goal: to escape from a dungeon filled with various obstacles. The primary purpose is to observe and analyze how the AI learns to navigate and overcome these challenges, focusing on the learning process itself. Additionally, the project aims to evaluate the capabilities and limitations of the AI engine, particularly in its response to new, user-generated scenarios, assessing the AI's adaptability and robustness in diverse and unpredictable environments.

1.2 Intended Audience and Reading Suggestions

This document has been specifically prepared for the professors of the Project course at the National University of Río Cuarto (UNRC) and for the members of the development team of the Dungeon Crawler-AI project. Additionally, it is intended for anyone interested in learning about the details and progress in the development of an AI engine based on reinforcement learning. The content of this document provides a comprehensive overview of the design, implementation, and evaluation process of the system, serving as a guide for both academic supervision and collaboration within the development team. Furthermore, it may be useful to researchers, students, and professionals who wish to delve deeper into the application of reinforcement learning in dynamic and complex environments.

1.3 Product Scope

The product scope for Dungeon Crawler-AI includes the following aspects:

1.3.1 Dungeon Completion: *The primary goal is for the game character to successfully navigate and complete the proposed dungeons, demonstrating progressively enhanced skills in overcoming obstacles at each level.*

1.3.2 Learning and Decision-Making: *The system should enable the character to learn from experiences and improve decision-making abilities over time. This involves the character adapting its behavior to navigate more effectively through dungeons and face challenges more intelligently.*

1.3.3 User-Generated Maps: *Users will have the capability to design and create their own custom maps. This feature allows for greater flexibility and creativity in crafting the challenges the character must overcome.*

1.3.4 Performance Evaluation: *Users will be able to assess how the character adapts and overcomes the challenges of the maps they create. This includes the ability to measure the time it takes for the character to learn to overcome obstacles and how performance improves relative to the difficulty of the maps.*

2. Overall Description

2.1 Product Perspective

The Dungeon Crawler-AI project is presented as a new, standalone product within the field of artificial intelligence and reinforcement learning. It is neither a follow-on member of an existing product family nor a replacement for current systems, but rather an innovation in itself that explores new applications of these technologies.

This product is designed to operate independently, with a specific focus on creating and testing reinforcement learning algorithms in a user-generated dungeon environment. The system allows users to design their own dungeons and assess how the AI engine adapts and improves its behavior to overcome the challenges presented.

Should Dungeon Crawler-AI be integrated as a component of a larger system in the future, the interactions between this software and other systems will be clearly defined. The initial focus is to maintain the product as an independent unit, with well-defined interfaces for map creation and performance evaluation of the character in the dungeons.

2.2 Product Functions

2.2.1. Login and Session Management System

- User authentication through username and password.
- Session management to keep users logged in during interaction with the system.
- Password recovery and identity verification.
- Options to log out and manage account settings.

2.2.2. Map Creator System

- Map Design Interface: Tools for creating and modifying maps, including the placement of obstacles, traps, and objectives.
- Element Customization: Options to customize the map design, such as the type and arrangement of obstacles.
- Testing and Simulation: Features to test the map in a simulated environment and adjust elements as needed.
- Saving and Loading Maps: Functions to save maps in progress and load previously created maps.

2.2.3. Pre-Trained Map System

- Provision of a set of pre-trained maps for the AI engine to test and adjust its algorithms.
- Performance evaluation of the AI engine on these maps to calibrate learning and adaptation.

2.2.4. Feedback and Map Sharing System

- Community Sharing: A platform for users to share their maps with the community.
- Evaluation and Comments: Features for other users to rate and comment on shared maps.
- Ranking and Recommendations: A ranking system to highlight the most popular or highly rated maps.

2.2.5. Efficiency and Security

- Performance Optimization: Ensuring that the system operates efficiently, even with multiple users and complex maps.
- Data Security: Implementing measures to protect user information and map data.

2.2.6. User-Friendly Interface

- Intuitive design to facilitate navigation and use of the system, both for map designers and players.
- Accessible assistance and documentation to guide users in creating and evaluating maps.

2.3 User Classes and Characteristics

The Dungeon Crawler-AI product is primarily intended for professionals interested in reinforcement learning, though advanced technical experience is not required to use it. The main user groups include:

1. Professors and Enthusiasts:

- **Frequency of Use:** Occasional, mainly for observing and experimenting with different maps.
- **Functions Used:** Creating custom maps, evaluating the AI's performance in user-generated scenarios, and analyzing the AI's learning process.
- **Technical Expertise:** Advanced technical experience is not required, although having a basic understanding of reinforcement learning can enhance the user experience.
- **Access and Privileges:** There are no distinctions in access levels or privileges within the system; all users have access to the same content and functions.

This group of users is interested in exploring how the AI learns and adapts in different environments without the need for intensive system usage.

2.4 Operating Environment

The Dungeon Crawler-AI software is designed to operate in any environment that supports Python and certain reinforcement learning libraries, such as Gymnasium. The system is implemented as a REST API, making it adaptable for a wide range of computing environments. Although compatible with general-purpose computers, the system is primarily optimized for Linux-based operating systems.

2.5 User Documentation

For Dungeon Crawler-AI, the following user documentation components will be provided:

1. Online README:

- **Description:** A comprehensive README file available online that provides essential information about installing, configuring, and using Dungeon Crawler-AI. It will cover key features such as map creation, AI performance evaluation, and available tools within the system.
- **Format:** HTML, accessible from the project's website. This README will include links to relevant sections for quick reference and updates.

2. In-App User Interface:

- **Description:** A user-friendly and detailed interface embedded within the application itself. This will provide contextual help and guidance as users interact with the system, including tooltips, step-by-step instructions, and easily accessible help sections.
- **Format:** Integrated into the application, with a focus on intuitive design to enhance user experience. The interface will offer real-time assistance and documentation relevant to the current tasks and features being used.

Delivery Formats and Standards:

- **HTML (Hypertext Markup Language):** Used for the online README to ensure accessibility and

- easy navigation through the documentation.
- **Integrated Interface:** Designed directly within the application to provide on-the-spot guidance and support, ensuring users have immediate access to help and instructions as they use the system.

The documentation will be maintained and updated regularly to reflect any changes or enhancements in the software, ensuring that users always have access to the most current information

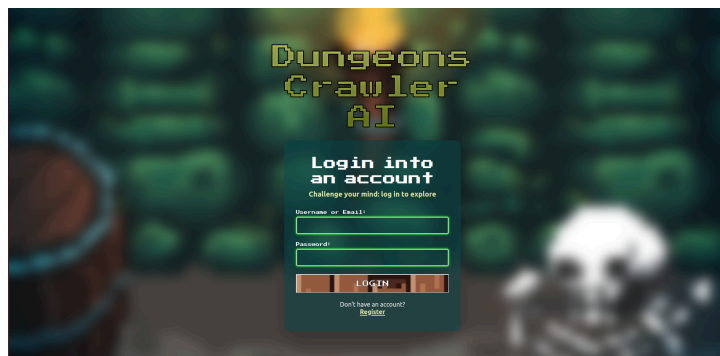
3. External Interface Requirements

3.1 User Interfaces

Dungeon Crawler-AI will feature a range of user interfaces, each designed to provide an intuitive and engaging experience within a pixel art dungeon theme. The application will be responsive, catering to both mobile and desktop users.

1. **Login Interface:** Users will start with a secure login screen featuring a pixel art design. This interface will include fields for username and password, and links for password recovery and account creation.
2. **Map Sharing Feed:** A dynamic feed where users can share and explore maps. The interface will allow for viewing, rating, and commenting on user-generated maps, all presented in a cohesive pixel art style.
3. **Creative Mode:** An interface for designing and customizing maps. It will offer tools for placing and adjusting obstacles, traps, and objectives within a user-friendly layout, maintaining the pixel art aesthetic.
4. **Runner Interface:** This will enable users to test their maps and observe the AI's performance. The interface will display real-time simulation results and performance metrics, all within the same pixel art theme.

Each interface will be designed with responsiveness in mind, ensuring a seamless experience across various devices. The visual design and interactive elements will follow established GUI standards, providing a consistent and user-friendly environment throughout the application.



3.2 Hardware Interfaces

Dungeon Crawler-AI is designed to work on a range of hardware setups:

- **Supported Devices:** *Primarily for desktops and laptops running Linux, with responsive design for mobile devices.*
- **Data and Control Interactions:** *Supports standard input devices (keyboard, mouse, touch) and displays graphics on various screen sizes and resolutions.*
- **Communication Protocols:** *Utilizes RESTful APIs for data exchange and standard formats like JSON for interactions.*
- **Hardware Requirements:** *Requires sufficient processing power, memory, and storage to handle AI computations and graphics efficiently.*

The software ensures compatibility and performance across different hardware config

4. System Requirements

System Functional Requirements

User Authentication:

- **REQ-1: User Login:** Authenticate users with username and password.
- **REQ-2: Password Recovery:** Provide password recovery options for forgotten credentials.
- **REQ-3: Session Management:** Maintain user sessions until logout or session expiry.

Map Creation:

- **REQ-4: Map Design Tools:** Provide tools for placing and configuring obstacles, traps, and objectives.
- **REQ-5: Save/Load Maps:** Allow users to save and load map designs.
- **REQ-6: Preview Maps:** Enable users to preview and test maps before finalizing.

AI Performance Testing:

- **REQ-7: Run Simulations:** Execute simulations of the AI navigating user-created maps.
- **REQ-8: Performance Metrics:** Display real-time performance metrics during simulations.
- **REQ-9: Error Handling:** Handle and report errors encountered during simulations.

Map Sharing:

- **REQ-10: Upload Maps:** Allow users to upload and share maps with the community.
- **REQ-11: View Maps:** Enable users to view and interact with shared maps.
- **REQ-12: Rate and Comment:** Provide functionality for rating and commenting on shared maps.

User Interface:

- **REQ-13: Responsive Design:** Ensure the interface is responsive for both mobile and desktop devices.
- **REQ-14: Pixel Art Theme:** Maintain a consistent pixel art design throughout the application.
- **REQ-15: Help and Documentation:** Include accessible help and documentation within the application.

Data Management:

- **REQ-16: Data Storage:** Store user data, map designs, and simulation results securely.
- **REQ-17: Data Backup:** Implement backup procedures for user-generated content and settings.

Security:

- **REQ-18: Secure Communication:** Use secure protocols for data transmission.
- **REQ-19: Access Control:** Ensure only authenticated users can access certain features.

Performance:

- **REQ-20: Optimize Performance:** Ensure the application runs efficiently on various hardware configurations.
- **REQ-21: Scalability:** Support a reasonable number of concurrent users and map creations.