

EDEE: A Flexible Environment for Research

Ningxuan Wang¹, Christopher Cullen¹ and Andrew Nuxoll¹

Abstract. In this paper, we present EDEE, a game environment that we believe is particularly well suited for AI research. EDEE is a complex, highly configurable game that is easy to create agents for due to its simple command structure and recognizable concept. To make this complex environment tenable for agents, we have created an interface design that presents the state of the game to the agent at three levels: an individual unit level, a tactical level and a map level.

1 INTRODUCTION

A major consideration for AI research is selecting an environment that will demonstrate the experimental outcome in a compelling manner but not unnecessarily interfere with or delay the research. We propose that an effective environment should have these properties:

- **Complex:** An environment that is too simple is not compelling.
- **Highly Configurable:** The more flexible an environment is, the easier it is to create a situation that focuses on the agent behavior. Flexible environments are also reusable.
- **Easy to Use:** Despite its complexity, it should be easy to develop an agent for the environment so that the researcher can focus on the AI.

In this paper, we present an environment called EDEE that meets these specifications. We present our interface for this environment and demonstrate how we expect it to expand with the complexity of our agents.

2 EDEE BASICS

The Empire Deluxe Enhanced Edition (EDEE) [1] is a turn-based, tactical strategy world-domination type game. We have found that it embodies each of the three qualities mentioned in the introduction:

- EDEE is complex. The environment supports 13 types of units and 35 types of terrain. The game also supports complex environmental effects like weather and fog of war. Playing the full EDEE game proficiently requires effective resource management and balancing simultaneous goals.
- EDEE is highly configurable. The game gives the user complex control over map generation including map size and ratios of each major type of terrain. A custom map editor is provided for creating a specific environment. The user controls what units are available to an agent. Furthermore, additional unit types can be added to the game without recompiling. The user can set up different rules and victory conditions. The task that an agent performs in the game can be as simple or complex as desired and all of this configuration can be performed without recompiling the environment.

- EDEE is simple to use. For simple tasks the agent need only issue two types of command: *create unit* and *move unit*. As a turn-based game played on a two-dimensional tile map, it is easy to control discrete unit actions and reproduce specific situations.

3 GAME INTERFACE CHALLENGE

To make EDEE convenient for use with AI agents, we wanted to adapt the existing interface to present the game state as a hierarchy of attribute-value pairs regardless of the complexity of the task. To illustrate the scope of this challenge, examples of three levels of complexity are presented below.

Simple Task

To date, we have used EDEE to conduct an AI research project to demonstrate learning with episodic memory [2]. We created a simple 10x10 map for this experiment and only one unit is active at a time. In this task, it is reasonable to present the entire state to the agent at all times.



Figure 1. A Simple Navigation Task with Episodic Memory

Figure 1 displays one path a unit might follow as it searches for a nearby city. Later, it uses its episodic memory to trace its previous paths in order to find the shortest one. Figure 2 shows the results of this experiment. The number of steps the agent takes to find the city decreases exponentially over time.

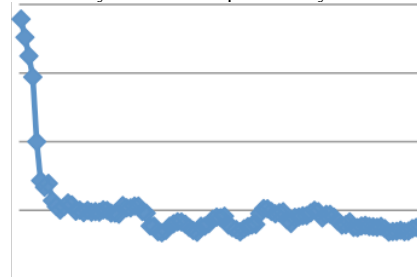


Figure 2. Number of steps to goal over successive iterations.

Medium Task

We've begun testing the feasibility of EDEE for an integrated task. In Figure 3 the agent must coordinate the actions of multiple units to locate its opponent on another island and then transport an assault force to that island. In this task, it is still possible to show the agent the entire state at once but the large amount of extraneous information hinders the agent's ability to act effectively.



Figure 3. An example of a medium difficult task.

Complex Task

In a complex task, an agent must be able to capture and defend multiple islands and manage a supply chain. The large map makes each state far too large to present to the agent in its entirety.

4 EDEE INTERFACE DESIGN

To address the game interface challenge, we designed game interface with two key features:

- **Unit Driven:** Each unit takes a turn receiving a command from the agent during each game turn. So, the agent can focus on one unit at a time rather than the entire game. This design was inspired by the human interface for EDEE, which uses the same approach.
- **Multi-Level:** The agent can zoom in to three different levels within the game: a unit level, a tactical level and a map level. We describe each of these below.

At the unit level, the agent can only examine a single unit and its immediate surroundings. An illustration of this level is shown in Figure 4. This level is sufficient for simple tasks.

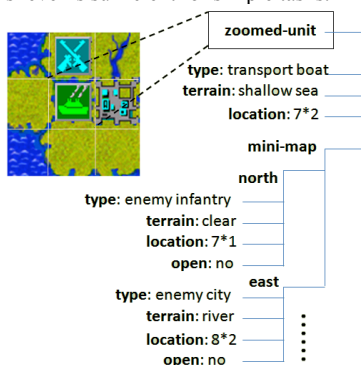


Figure 3. An example of unit level information.

At the tactical level, the agent can zoom out to a specific, larger area (e.g., an island). Information provided to the agent is focused on each player's military power in that area such as the numbers of cities and units. This level may be used to make a tactical plan to conquer or secure an area. The interface is responsible for defining the extent of each island.

At the map level, the agent can view a list of islands that comprise the global map. It will also group related areas into a larger control zone. This level may be used to make a strategic plan to dominate the world.

5 CONCLUSION

EDEE is a complex and highly configurable game that is easy for an agent to play. However, as a complex environment it is difficult to present to an agent in a form that is conducive to learning and overall effective play. We have presented our design for a unit-driven, multi-level interface that allows the agent to separate tactical and strategic decisions from individual unit movements. We expect this interface to allow an AI researcher to use EDEE at all levels of complexity.

REFERENCES

- [1] M. Kinkead. *Empire Deluxe Enhanced Edition information page*. Killer Bee Software, <http://www.killerbeessoftware.com/kbsgames/edee/>.
- [2] Ningxuan Wang, CJ Cullen, Andrew Nuxoll. "Episodic Memory for a Simple Empire Game Environment." *University of Portland Wilson W. Clark Memorial Library*. http://library2.up.edu/ereserves/nuxoll_4xx_01.pdf.