AASMA 2021 Project Proposal

Group 49

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ABSTRACT

Turn-based strategy (TBS) games have dramatically increased in popularity over the past decades, and as such, have become a popular field for the development of Artificial Intelligence. As the scope of video games starts going beyond mere entertainment into areas such as corporate management and military use, it becomes increasingly important to use intelligent systems to truly understand how to make the most out of the complex interactions these games allow. As games such as these grow more and more, developing theoretically optimal strategies for the AI to manage its available resources becomes relevant to get the upper hand on its opponents, while also adapting its own strategy to the ones of its enemies.

In this paper, we propose the implementation of a simple medieval-style TBS game concerning resource and troop management in a village. We also discuss the future implementation of a competition-based multiagent system for this game, where each agent represents a player controlling a village, following a horizontally-layered hybrid architecture. Finally, we discuss the metrics that will be used to assess the performance of these agents, such as the power of its military force and its successful and failed attacks.

1 Introduction

As turn-based strategy (TBS) games have increased remarkably in fame since their inception in the late 1970s, they have also become an increasingly popular focus area in the AI field. Intelligent agents can quickly learn how to navigate significantly complex environments such as these; hence, as video games start showing uses in many other relevant fields, learning adequate strategies for these games becomes pertinent.

With this project we would like to explore the subject of competition-based multiagent systems in the context of TBS games, taking inspiration from already existing games such as the Civilization series[1] and other similar games such as Tribal Wars[2] to create an environment which corresponds to a simpler, more basic version of these games where each agent acts as a player, competing in a free-for-all scenario until one of them is crowned the winner.

In short, each agent manages a village in a medieval setting where they must take decisions regarding resource management and troop mobilization to defeat other players while also staying alive and maintaining the prosperity of its village.

We aim to develop agents that can devise successful strategies using reactive and complex deliberation mechanisms, dependent on the specific circumstances of each game.

The success of the project depends on how effective the strategies developed by the agents are, how well each agent can adapt to the strategies of others, and the ability for each agent to take reactive and/or proactive decisions appropriately, given the established metrics.

2 Approach

The environment in which the agents will operate consists of a group of villages, in which each of them belongs to its own agent, who can build new infrastructure for it, upgrade it, and take advantage of it to increase its productivity and grow its military force.

There are 7 available buildings, which are all upgradeable and all serve different needs:

- The mine provides iron to the village. The more it is upgraded, the more iron is extracted.
- The quarry provides stone to the village. The more it is upgraded, the more stone is extracted.
- The sawmill provides wood to the village. The more it is upgraded, the more wood is gathered.
- The warehouse is where all the village's resources are stored. Upgrading it will increase the maximum storage capacity of each resource.

[1] To find out more: https://en.wikipedia.org/wiki/Civilization_(series)

[2] To find out more: https://en.wikipedia.org/wiki/Tribal_Wars

- The market allows for resource trading between villages. Each agent can create its own market offers, which can then be accepted by other agents interested in the trade. Upgrading it will increase the volume of resources that can be traded at once.
- The farm determines how big the population of the village can be. The higher it is upgraded, the more population the village will be able to sustain, increasing the maximum number of peasants of the village.
- The barracks are used to recruit troops. Upgrading the barracks unlocks the recruitment of different, more specialized types of troops. More on this below.
- The wall provides a defensive bonus to the troops defending the village. The higher it is upgraded, the higher the defensive bonus is.

Building, upgrading, and recruiting all have their own specific resource costs, which are divided among the three different resources already mentioned: stone, iron, and wood. Recruiting troops also consumes a peasant alongside the other three resources, and demoting it returns that peasant.

There are three types of units available, each with a different purpose, excelling at a specific task:

- Warriors are the cheapest units to recruit but are also the weakest. They are the first unit available in the barracks, with equal offensive and defensive power. While they pale in comparison to other troops, their cheap cost and low barracks level requirement allows for strength in numbers.
- Archers are the second available unit in the barracks and are more expensive than warriors. They excel at defense, therefore becoming great assets when placed in a village to defend it, while lacking in offensive power.
- Catapults are the last available unit in the barracks and the most expensive. Their strength lies in its great offensive power, which makes it the best unit to perform attacks on other villages. Their offensive power is offset by its low defensive power.

Units can be used to attack other villages. The outcome of an attack is determined by which side has higher power, calculated based on the attack or defense power of its unit types (depending on the side), the number of units of each type and a random luck factor. The losing army is wiped out, whereas the casualties of the winning army are based on the magnitude of the win and by a separate luck factor.

A victorious attack on a village depletes its health points. Once a village's health points drop to zero, the player controlling that village loses. The last surviving player is crowned the winner.

Each agent possesses a set of sensors and actuators. The sensors provide the agent with complete information on the state of its village, as well as the names of all the other villages of agents that are still playing the game and their currently available market trades. The actuators allow the agents to create new buildings, upgrade existing ones, recruit and demote units, create and accept trades, and send attacks.

Every turn, each agent may take up to one upgrade decision (erecting a new building or upgrading an existing one), one recruitment decision (recruiting or demoting any number of units of a specific unit type), one trading decision (creating a market trade or accepting a trade of another agent), and one attack decision (sending off a specified number of troops of specific unit types to attack a single village).

The agents will follow a hybrid horizontally-layered architecture with at least two layers, one focused on reactive decision-making and the other focused on deliberative and proactive decisions. These two modules will work independently, returning the decision taken and a degree of confidence regarding that decision. A decision module will receive these inputs and make a final decision based on the decisions and degrees of confidence outputted by each layer and the similarities / differences between the decisions taken.

A hybrid architecture is a good choice to solve the problem because although there may be good reactive principles that an agent can follow, a purely reactive behavior is inadequate considering the complexity and non-determinism of the environment. Developing a theoretically optimal purely reactive agent in such an environment is a cumbersome and essentially unfeasible task. Additionally, an agent must be proactive and predictive regarding what other players may do to achieve a good level of play.

3 Empirical evaluation

Several metrics can be used to assess the performance of all the agents combined, as well as each agent specifically. These metrics include:

- A turn counter which keeps track of the current turn the agents are playing, as well as a record of the amount of turns each game takes and the amount of turns each agent stays alive in each game.
- A counter that tracks successful and failed attacks and defenses, plus total troop casualties per agent.
- A record that keeps track of the changes in health to each agent's village.
- A record that keeps track of changes to the "prosperity rating" of each village, a rating that reflects how much the buildings in the village are developed / upgraded.
- A record that keeps track of changes to a village's offensive and defensive powers.