AI Scripting for Microsoft™ Age of Empires II™

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Aim:

To write an AI script that will defeat the standard AI of Age of Empires II: The Conquerors 1.0c (AoC) using principles learned in CS 621: Artificial Intelligence, and the AI scripting mechanism provided by Microsoft for AoC.

Introduction

Microsoft™ Age of Empires II: Age of Kings™ (AoK) is one of the most popular Real-Time Strategy games of our time. Originally released in 1999 and followed by an expansion pack called Age of Empires II: The Conquerors™ in 2000. It has developed an extensive, thriving community centred on developing custom maps, scenarios, campaigns and AIs.[1] The immense popularity of AoC has spawned a number of modified maps, open-source clones, etc.[2]

AoC has 18 different civlizations, each with its own unique technologies and units. The Tech Tree of common technologies spans four distinct ages, representing real historic periods. The wide variety available in units, technologies, formations, terrain and other parts of the game make it very complex game in terms of AI.

The gameplay involves a player controlling some units and buildings to gather resources, research technologies and build more powerful units and buildings. The end target varies from utterly destroying the enemy players' units and buildings (Conquest) to guarding a position or an object for a certain period of time (King of the Hill) to killing a specific unit of the enemy player (Regicide).

The multiplayer mode of the game involves humans and computer-controlled players teaming up in various combinations. Multiple humans can control the same in-game player, or humans can co-operate with the computer and control a single player.

[1] The Age of Kings Heaven is perhaps the largest of these.

[2] A popular mod called The User Patch considerably enhances the game, in graphics capability, AI configurability, and a lot more. However, at least initially, we won't be using it.

Economy

Civilian units, called "villagers", are used to gather resources. Resources can be used to train units, construct buildings, and research technologies, among other things; for example, players can research better armour for infantry units. The game offers four types of resources: food, wood, gold, and stone. Food is obtained by hunting animals, gathering berries, harvesting livestock, farming, and shore fishing and fishing from boats. Wood is gathered by chopping down trees. Gold is obtained from either gold mines, trade or collecting relics in a monastery, and stone is collected from stone mines. Villagers require checkpoints, typically depository buildings (Town Center, mining camps, mills, and lumber yards), where they can store gathered resources.

Every player has a limit to the number of units they can create a population limit but may not immediately use the entire potential population. The population capacity, which can be capped at anywhere between 75 - 200 in intervals of 25, is based on the number of houses, Castles, or Town Centers – the main building in a player's town – which have been built.

Strategy and Logistics

The land military units are broadly categorized into infantry, cavalry, archers and siege weapons. Most types have a corresponding counter-unit, which is specialized against the original. There are units which blur the lines - such as cavalry archers or camel-riders. Further, the individual civilizations have their own strengths and weakness when it comes to the various military units. Franks (equivalent to modern-day French) produce stronger cavalry than most other civilizations, whereas the Teutons produce particularly powerful infantry. The Celts feature infantry using throwing axes, thus giving them ranged abilities without the typical weakness of archers. And so on for the other civilizations.

Strategic decisions are of immense importance in a Real-Time Strategy game like AoC. The layout of the terrain, availability of resources, locations of allies, strengths and weaknesses of their civilizations, all go into deciding a good strategy, which acts as an overall guide, or framework, using which the individual players make appropriate tactical decisions. We must also consider the logistics involved:

- Movement of armies:
  - Over land: Slower, delicate units such as siege weapons and monks need to be protected. Exploit the speed of mounted units to ward off attacks on the main army.
  - Over sea: Transport ships have limited capacity and units in ships cannot defend themselves. If the enemy is across a body of water, one must set up a base on enemy territory.
- Replenishment of armies after battles and skirmishes:
  - Maintaining a level of resources, to allow for quick replenishment.
  - Ensuring proper timing of arrival of reinforcements.
- Retreating under fire while minimizing losses.

Scripting

Scripting in AoC is based on a proprietary system provided by Microsoft. A vaguely Lisp-like language is used throughout. The essential form of a command in a script looks like this:

(
set of conditions => set of actions
)

While the basic form of the language might look simple, the number of conditions and actions available is immense. Aside from these conditions and actions, there are also hundreds of game-play parameters called strategic numbers. Changing some of these numbers can drastically alter the course of game.

Since the AI engine is able to run through the script at speeds well above the average human's reactions, AI players face some limitations. For example, only one player might be started on constructing a building. The default strategic numbers that govern an AI player's military units are also different.

Finally, unlike in the original Age of Empires, the standard AI engine in AoC can, and (at higher difficulty levels) does, cheat.[3] This is done, for example, by the standard AI giving itself free resources on occasion. But an AI script cannot benefit from this "feature". All these issues must be taken into account when writing the script.

Conclusion

Implementing the AI script can be broadly classified into three sections:

1. Balancing the economy - maintaining levels of production, researching technology and advancing through the ages, maintaining population (both available and used), etc.

2. Managing the military - production of balanced armies, timing the attacks, replenishing units and so on.

3. Fine-tuning the strategy - Adding rules for each civilization's strengths and weaknesses, variations based on the terrain and game style and so on. Thus an overall strategy coordinates the economy and military.

Writing a strong AI script requires both focusing the details and, at the same time, keeping an eye on the big picture. We believe that the innate duality of the details - economic and military - combined with the need for attention to the overall scheme of things make this project perfect for three people.

[3] Archived copy of AoC AI specialist Dave Pottinger's interview.