Artificial Intelligence in The Sims series

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Résumé

This paper describes roughly the AI techniques involved in the world famous video games series The Sims. A quick introduction to the game will be followed by a description of the pathfinding algorithm (HDA*). The core of the game, the decision making process, will then be highlighted, introducing the concept of Smart Objects. We will briefly go over social interactions, and then discuss the scaling of the simulation (level of detail mecanism) and the improvements brought by later versions of the game. Finally, we will review the public reaction to those techniques and raise our own prospects. This document is a small add-on to the slides available at www.YoannBourse.com.

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1 The Game

1.1 History

The Sims is the result of Will Wright's work on simulation, popularized by the very successful SimCity (1989). During the 90s, he developed several simulation games based on animals or ecosystems, like SimAnt, whose concepts might hint the future Smart Object paradigm. This evolution will lead to the creation of The Sims (2000), a game simulating human behaviour.

The game offers an incredible modularity and will be followed by a lot of expansion sets and items packs, and several new versions offering a renewal of the game mechanics. However, the underlying AI did not evolve a lot between the first and the latest version.

1.2 The Sims

The Sims is a sandbox god game which simulates the life of a human-like family (called Sims). After its release in february 2000, it became the best selling PC game, a title it still holds (6.3 million sales then, 16 million now). It is reported that this game might totalize the highest number of hours played around the world. Plus, it is recognized as one of the most influencial AI of all time (AIGameDev.com).

1.3 Player/AI

The player has a wide range of possible actions and can be good or evil. He can design sims and the houses they live in. He can also give them orders, although he can only control a family at a time. Other sims are controlled by the computer. The AI also handles elementary actions (like pathfinding) and provides a default behaviour for the sims : they are able to survive without the player's intervention. This lead to one of the most important aspects of the game, which lead to its popularity : the automatic generation of narration. Sims can live by themselves and thereby create story. Some players enjoyed just setting up the game and watching what would happen ("fishtank" behaviour). However, the AI performing this default behavious must not be too efficient, or the players would have no incentive to play. The sims AI takes place at several levels :

– Pathfinding
– Decision making (free will)
– Social interactions

2 Pathfinding

The pathfinding problem is very simple : how does a sim go from A to B ?

2.1 A*

A* is a widely spread heuristic method to find a path towards a goal in a greedy manner in a graph. It simply consists of making a step towards the neighbour minimizing $d + h$, where d is the distance to this neighbour and h an estimate of the distance between the

neighbour and the final goal. If this estimate is an underestimate, A* will yield the shortest path to the goal. A good underestimate is often the geometric distance ignoring obstacles

2.2 HPA*

Most games adapt A* into **Hierarchical Pathfinding A*** (2004). The idea is very simple : instead of working on all the possible positions, we will group these positions into regions, and those regions into bigger regions, and we will proceed at different level of details, finding first a path amongst the biggest regions, then defining the path within those regions by working on the smaller regions, and so on... The Sims uses as a first division the straightforward division of the environment into rooms, and then applies the classical HPA* algorithm. Several smoothing algorithms are applied on top of that, to offer smooth curves for instance. A demonstration video is available on youtube : http ://www.youtube.com/watch ?v=iI-R4M-yIzo

3 Decision making

The decision making process heavily relies on how the sims model human behaviour. This is done through 8 basic need factors which will evolve over time, including :
Physical needs :
  – Hunger satisfied by eating
  – Comfort satisfied by sitting or laying down
  – Hygiene satisfied by bathing
  – Bladder satisfied by urinating
Mental needs :
  – Energy satisfied by sleeping
  – Fun satisfied by playing
  – Social satisfied by interacting with others
  – Room computed per room based on architecture, furniture...
Each of these factors evolve differently and are influenced by the activities of the sim (Energy doesn't drop while sleeping, Bladder skyrockets while eating...). Those factors are then translated into happiness level, each according to a different rate (an half-empty bladder is less annoying than a half-empty stomach). The distance between the sim and the object is also taken into account by a small multiplicative factor.
The sim then chooses the activity that can increase its happiness the most. In order not to be perfect, the algorithm chooses amongst the 4 best options to improve happiness. Future versions will choose the activity with a probability propotional to the hapiness gain following a Boltzman equation. The temperature in it diferent for each activity and is based on Maslow's Hierarchy of Needs.

3.1 Smart Objects

Actually, none of the logic is stored in the sims : all of the logic is in the objects, hence the denomination "Smart Object". This is responsible for the numerous expansion packs of the game. Each object of the world corresponds to a thread and contains, on top of its graphic and animations, the scripts required to follow for the different actions, written in the

EDITH custom script language. The object also advertizes the sim by broadcasting what it can offer to it (which will be translated into hapiness = utility). Note that this smart object paradigm is so powerful that it is used everywhere : visiting neighbours, but also weather and conversations are virtual objects.

3.2 Taking personalities into account

Each sim also has different personalities traits which will govern interaction with its environment (playful people will derive fun from pinballs whereas serious people will derive fun from books and chess), but also its own personal evolution (outgoing people's social need increase faster).

4 Social interactions

The social interaction system is based on a score between each pair of sims. Depending on this score, the relationship is in a different status (enemy, acquaintance, friend...) resulting in different possible actions. Hence the high-leve automaton-like description of the social aspect of the game.
On the other hand, these interactions can have positive or negative results depending on the mood, personality of the sims, circumstances or even plain randomness. This is described by a precise rule system.

5 Evolution in the franchise

5.1 Scalability

In order to take into account aging and to provide a more immersive experience to the player, the whole town had to evolve even when the player was not actually watching. The full simulation of all the sims would be way to costly, so a clever play on the levels of details has been used : an average behaviour is scripted, enabling way faster computation. Hierarchical planning also improves efficiency : Instead of considering all possible actions, choose a house, then choose an object, then choose an action. We don't have to update all the sims at a time. Another improvment consists in using a different map for every type of need (commodity map).
The town is also considered as an object with desires (maintaining a gender ratio, an employment rate), and as sims drink to satisfy their thirst, the town has several actions to satisfy its needs (birth, death, create job, fire people...).

5.2 Realistic simulation

Realism is increased by adding new contextual needs according to the personality of the sims or the events. For instance, during a visit, the host will have an additional need to welcome and entertain his guest. Kleptomaniacs will have the permanent need to steal something...

6 Prospects and conclusion

6.1 Post-Mortem

Although the semi-autonomous groundbreaking AI responsible for the decision making was widely acclaimed because it enabled a light used control and the generation of narratives, the pathfinding algorithms were criticized for not being efficient enough : sims would get stuck/lost.

6.2 Prospects

As a conclusion, we would like to raise the question of user-based adaptation in the Sims. The game mechanics are the same for everybody, and as the user is at the center of this game, it could benefit from learning mechanisms. A simple idea is to provide the players with the possibility to teach the baby sims by reinforcement learning, much like in the game Creatures, so as to provide an alternative to the simple DNA mixing.

6.3 Sources

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