Artificial intelligence and video games
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The article you are reading has not been written by a robot - or not yet at any rate. But it is only a matter of time before this becomes a reality. Certain press releases are already being written by robots (these involve company accounts, sporting events or earthquake notifications, for example), translators take part in your conferences by Skype and the Google pilotless car has already travelled more than a million kilometers without a single hitch which is a better record in terms of safety than that of a conventional driver. Behind these major developments are: the fabulous progress that has been made by artificial intelligence systems in recent times. Some of these developments are due to the creation and perfection of video games. According to research results that have just been published (1), a team from the University of Liège is revisiting the design of artificial intelligence systems used in video games by defining a middleware, a kind of software intermediary between what is common to the artificial intelligence of all these games and their specific instantiations.

Damien Ernst, who is a professor in the department of Electrical Engineering and Computer Science at the University of Liège, is without doubt better known for his work on electrical networks and his studies of blackouts (see electric energy: what does the future hold? and his blog) than for his skills in artificial intelligence (AI). However, some of his work (see Electrical networks in the connections between neurons) has led to the idea that AI is the central preoccupation of the research carried out by this group. "We have a long tradition of using AI techniques for decision-making purposes in electrical networks", explains Damien Ernst. "Electric networks are certainly very complex; humans need to be assisted by AI tools in order to make good decisions". Damien Ernst's team has not, however, contented itself with the use of AI techniques and has succeeded in making seminal contributions in the area because the real problems associated with electrical networks that needed to be solved have been a source of ideas and a formidable area of experimentation in terms of the development of new AI systems. Some algorithms and AI modules developed by the researchers from Liège have thereby become international standards.

Algorithms

"We have an algorithmic vision of AI", explains Damien Ernst; "these are algorithms and software programs that process information in order to extract intelligent decisions from this information. AI is more and more present in commercial products: the Google search engine and tools for the automatic translation of texts..."
can be seen as artificial intelligence systems. The ultimate objective of research in this area is to create true intelligent and autonomous entities that greatly exceed all the cognitive faculties of human beings". The scene has been set…but we are a long way from video games.

The intrusion of video games into the research carried out by the team from Liège is perhaps first and foremost the result of a passion, that of Firas Safadi, a young doctoral student and accomplished gamer in the research laboratory! But it is also undoubtedly a question of culture and potential industrial development (the money generated by the world market was around 70 billion euros last year, the biggest entertainment industry in the world ahead of even music and film industries). Above all else, however, the reason for the intrusion of video games into this research is technological: "there is a problem that is plain for everyone to see", explains Firas Safadi: "the quality of AI in video games is not sufficient. AI is, for example, the opponent we play against. But there are also simpler applications the aim of which is to animate entities in the games: for example, a dog that we interact with. This interaction must at least give the player the impression that this entity is intelligent without it having to actually be intelligent".

Over the last ten years, the realism of the games has improved considerably to the point where graphic performances have reached the point where players are immersed in a quasi-real world, but the performances of AI systems have not followed suit. This has led to a dichotomy. From the point of view of graphics, there is a similarity between reality and games; from the point of view of intelligence, there is a big difference with reality. "As graphics become more and more convincing, the difference has become increasingly marked: a very real form which does not at all act in a realistic way"! There is therefore some incoherence between the visual level and the level of AI of the different characters. In order to set themselves apart from their competitors, the actors in the sector have to "pull out all the stops" with regard to the development of much more efficient AI.

In fact, in a racing game, for example, the computer does not really drive the vehicle the same way the player does; it simply guides the car by means of a series of possibilities and restrictions without knowing whether these are valid or necessary. Rather than worrying about whether the vehicle accelerates or decelerates with correct, plausible values, it cheats in order not to be beaten by the player. "We therefore have the impression that the computer cheats, does not play by the same rules as ours", continues Damien Ernst. "To prevent this, the computer, has to consider the car as another player and use an AI algorithm to drive it, an algorithm capable of taking the same decisions as the human player". If the AI of video games is of insufficient quality, this is because in competitive
situations where a human being is pitted against a computer, the human is much better than the machine. This affirmation may seem strange if we remember, for example, the victories recorded by computers over the best chess players. "In cases like those", explains Raphael Fonteneau, a researcher at the FNRS, "AI systems have sometimes succeeded in solving the game completely (without cheating!), but only in very structured, narrow environments where the rules can be defined precisely and are not so numerous: in addition, the solution to the game is based on the memorization of possibilities. But the computer is poor at appreciating a rich environment and this is what needs to be improved upon".

**Common basis**

The work of the researchers from Liège and in particular that of Firas Safadi, including that which constitutes the core of his doctoral thesis, has attempted to get a grasp of the generic needs of AI developers for video games. Though game developers would certainly appreciate not having to build and AI from scratch for each game, they often find themselves forced to. However, while different AI solutions can give the impression of being different, they have in reality very similar requirements. The researchers from Liège have therefore considered that it was possible to create a generic AI system to which an adaptation layer could be added, making a connection between the specific needs of each video game. Firas Safadi worked on this transition layer between the two (middleware), between a generic AI and games. Thanks to his developments, it will no longer be necessary to design AI specific to each game (which is impossible, and it is this fact that affects the quality of current games). On the contrary, game designers will be able to use a generic AI and apply it to a large range of games.

Firas Safadi explains, "My contribution has been to consider games as a collection of independent conceptual problems. It is necessary to completely separate the development of these games and the development of AI. Game developers must continue to develop them but must do so without worrying about the AI part while AI developers are going to do it without knowing which game this AI will be used in! The mistake that has been made to date has been to want to standardize AI solutions and to try to develop standard AI systems for the conceptual problems they encountered". Raphael Fonteneau continues, "If we want to make an analogy, we could take the example of the Android platform, an open-source mobile operating system developed independently of the phones in which it is installed. This is similar to what we have done here for video games: creating a platform to which everyone can contribute".

The researchers from Liège have developed a conceptual middleware prototype; they then rewrote the code for a video game to which they had access but by adopting the separation between AI and video game and inserting a conceptual middleware between them, between the algorithm of the AI and the game part, so to speak. They then took another very different game and succeeded in using AI modules developed for the first game in the second game. In the latter case, the middleware was simply completed (and not totally modified) because it was made to measure for the requirements of the first game. Of course, in its definitive form, this middleware should no longer need to be completed (or at least barely so) because it should take into account the requirements of most games. It was thereby shown that very little effort was required to make use of this middleware in another game.

**Contribution of video games**

This also shows how games can help AI research. It is a field that is mostly driven by tests, by trial and error. Before the development of video games, tests were quite simple: chess, the game of go,
queens or small artificial games that researchers constructed for the purpose in hand. But there were no environments that were similar to those in which human beings evolve. These are environments that require far greater cognitive faculties than those used to solve a game of chess, for example.

Today, thanks to games, researchers can test their AI algorithms in environments which are similar to those in which human beings evolve. "And this has really changed the speed of development of new AIs, it has accelerated the process. If we take the example of Deep Mind based in London, which has been bought over by Google whose objective is to create the first real AI by using technologies close to those developed here: this company has institutionalized the video game as an experimental platform for its researchers in order to construct the first universal AI as portrayed by the intelligent robots that appear in movies...for now this is still science-fiction but not for much longer"! Explains Damien Ernst.