

Game Designs based on Machine Learning Systems

Yichong Chen

University of Utah, Salt Lake City 84112, USA

u1391350@uemail.utah.edu

Abstract. Contemporarily, there are many games as follow a storyline in the game industry. On this basis, NPCs are acting under a setup. In this paper, several machine learning systems are creating games and art pieces by themselves. Readers can see how different machine learning system works to form different games. Based on the procedure and evaluations, it will help a lot of game developers to create a full AI system for creating different levels, NPC, monsters, and missions. Therefore, it will create a world that is even more freedom for players to play. ANGELINA system and those two art systems based on machine learning they are creating some random production by themselves, and all the works are high quality. The purpose of this paper is to demonstrate the functions machine learning works in the field of game creation. These results shed light on guiding further exploration of game developing in terms of machine learning scenarios.

Keywords: AGELINA System; CCE; Scene-Net Model; Gan System; Convolutional Layers.

1. Introduction

Contemporarily, as the society develop, machine learning has become popular and widely used in various fields [1-3]. Machine learning is mainly about a field which is based of understanding and building how to learn. In general, machine leaning appears in genetic sequence analysis, computer security, computer image processing, etc. All of these are done by machine learning will be more efficient and convenience. Owing to some kinds of program, using example to training machine learning will be a better choice for any programmer to use than using predictions. As a consequence, machine learning is making those scientific researches more convenience and it plays an important role in helping to solve those basic scientific questions.

By the time of developing machine learning, there are more and more place which are using machine learning. As the time goes, because of the accurate and efficient of machine learning, it will be using in more and more areas than today. For example, machine learning will be using way more a lot in marketing in the future, the article said that from 2016 to 2022, machine learning market will have a big increase by 44.1% from USD 1.03 billion to USD 8.81 billion [4]. In this situation, machine learning makes a big profit to the whole market.

Although it is just a prediction of what will future profit look like, through machine learning, it can let people to see what will be and prepare for those unpredictable events which will happened next. Therefore, by using more machine learning, it will make people's life be smoother and easier. Hence, it can bring up the society and reduce those unexpected events happened. Moreover, at the time of 5G developing, machine learning makes the process be very convenience. Adversarial autoencoders (AAE), a machine learning procedure that uses power spectral density data in an unsupervised learning environment to detect anomalies in the wireless spectrum, have now been used to tackle this task [5]. Machine learning is helping people to detective the anomalies in the wireless spectrum. It just detective by itself which without any help from human. It is making the job be very efficient and easier, even reduce many of unnecessary mistake which human could create. Nowadays, that machine learning stands a big role in scientific development. In the future, it is not only are making people's life and scientific research more convenient, but machine learning could also help people to develop something which is impossible to create right now, such as a real human robot which can speak, think, and feel emotion. Therefore, in the long period of developing, machine learning could be using in every single place and let human technology go to a new level.

In the game industry, machine learning also stand a big role in game development. Usually, when a player paying the game, all the players' data could upload to that game company's server. As a game developer, scholars always want to making games be more fun and let player having a good game experience. However, some of the games as based on player's actions and data to change what will happened next. When the developers go to the servers and see those big bunch of data, it could be a big mass because there are thousands, and thousands of players' data are in the server. Therefore, after put machine learning into the game, it can predict what will user do and what will user go. Thus, it could let system to make the users' game be different. Additionally, in the art sections, game developers only can design some monsters and landscape which is based on human awareness. However, machine learning could help developer to create some kinds of game concepts which is out of human awareness. Therefore, have machine learning in game developing could bring out a new level of design and a different kind of art still for players.

This paper aims at illustrating machine learning which can create game level and art. As all the games which appear on the internet, there is no game are like this by using machine learning to design game items by itself. Therefore, in the future, these systems will play an important role in the future of game design. In this research, there will be some summary of other machine learning algorithm, result, limitation, and future expectations. The rest part of the paper is organized as follows. The Sec. 2 will talk about AGELINA system, which is AI level design system. The Sec. 3 will discuss AI art creating system. The Sec. 4 will demonstrate the limitations of the systems as well as the future expectations accordingly. Eventually, a brief summary is given in Sec. 5.

2. AGELINA System

In games, level design plays an important role in the development of the game. A good style of art can attract and hole many players to keep playing this game. Through development, machine learning starts to help and be a part of the design. Machine learning becomes another partner who is for those developers to cooperate. In some of the games, by using some algorithms, the system makes its level out. ANGELINA system is one of the famous systems that can create game levels by machine learning [6]. ANGELINA system's first version is using the prototype CCE system to create some arcade games. Further developing, it makes the creation more joinable, more fundable, and more completable. According to The ANGELINA Videogame Design System—Part I Section II, the core, CCE system, is the pillar of the ANGELINA system, and multiple distinct evolutionary subsystems build this system, and these distinct evolutionary subsystems are called species. Every species is solving a particular problem differently. CCE system just separates a huge problem set into different groups and uses the most efficient way to solve it. Mostly, the CCE system appears in 3 ways of classification of decomposition strategies. The first one is called random decomposition. This is telling that the order of genes is randomly selected, but the user must decide the number of groups and the size of the groups. The second one is a perturbation. This is to use several methods to perturb the decision variables to try to group the variables. The third way is called model construction. This is a probability model based on the number of individuals s , which is iteratively updated in the evolutionary process. During further developments, the CCE system is always there and has never been changed. For example, there is work done by two people who are Potter and De Jong. In this work, the example system solves a function optimization problem, where a mathematical function that contains several variables has optimal values for those variables set by a CCE system. Based on that, although the CCE system is just finding and efficiently solving problems, it is still helping the ANGELINA system to be more efficient and set as a core for building up the whole ANGELINA system [7].

After the introduction of the CCE system, back to ANGELINA itself. ANGELINA usually works with CCE and another important system called the evolutionary system. According to The ANGELINA Videogame Design System—Part I Section III, mostly, the ANGELINA system is written in java. The evolutionary system relies upon the Monkey HTML5 engine to output its games.

These two systems usually work together. The evolutionary system will build up the basic structure and point out the place where ANGELINA needs to plug all the detailed information. Normally, ANGELINA will plug the game rule and level layout into the structure. By the time when an evolutionary cycle end, ANGELINA will plug that information in. This is how ANGELINA and the evolutionary system work together.

Most of the time, the CCE core of ANGELINA will be separated into 3 species. The first one is RS1 which is called ruleset design, the second one is LV1 which is called level design, and the third one is LY1 which is called layout design. LV1 holds the information on the path that player can go and where cannot go. LY2 is holding NPC object, player object, or the information of control characters. Here is the code for how these parts run together:
$$\begin{matrix} \text{Type} \\ 1 + \text{Type} \\ 2: \text{Effect} \\ 1 + \text{Effect} \\ 2 + \text{Score} \end{matrix}$$
 In a simple way to say is Type1 + Type2: Effect 1 + Effect2 + Score. In this rule, Type 1 and Type 2 are two Objects. Effect 1 is applied to object one which is Type 1 and Effect 2 is applied to object one which is Type 2. Additionally, the score is added to the global score. These objects are chosen from entitles, such as a player object, color entitles, wall, enemies, etc. Effects are hardcoded game concepts, such as object resurrection or death.

Based on the species, it will be separated into two kinds of code that going to process all the data and information. The first is regular grammar which is dealing with those species like level design and setting up. However, another one is abstract grammar. This kind of grammar is dealing with game rules. When the game is created, as shown in Fig. 1, ANGELINA needs to evaluate the game. Therefore, if ANGELINA wants to test the game, it will set some AI to help to see if the game is ok or not. Normally, it will be using 3 ways to test the game. The first way is to let AI stand in one spot. The second way is to randomly let AI randomly control the game character. The last way is to make AI has varying levels of risk aversion while it playing the game. Comparing the results from the different performances of AI which are the first 2 ways, it helps a lot to see the game whether is fun, challenging, or fair for the player. Moreover, the third way is helping the computer to see what kind of game this is and whether the game has corrected the challenge or not which can lead to game risk factors.

When CCE wants to develop another generation of games, it will keep saving parent data for the next generation to use. At the beginning of the CCE system, the CCE system cannot fit new data. Therefore, the saving of parent data can recover the drop-in fitness. Also, it can train those objects to work with other parts of the system. Although the ANGELINA system is huge and complex, it brings up the development of machine learning and game design. In the future, ANGELINA use and help in more careers for helping human technology develop.

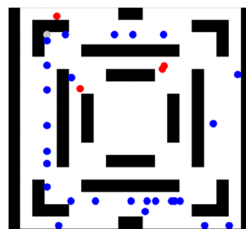


Fig 1. The game that AGELINA creates.

3. AI Art Creating System

Furthermore, art is also very important in game design. In retrospect, many AIs are helping to make some art pieces. At present, some machine-learning art systems are creating art by themselves. AI-creating models could be the ones that are out of human awareness, so it can help game developers to have more ideas on game making. However, nowadays, AI-creating models are not much. If developers want to create some creature in the game which is out of human awareness, these AI art systems are some good choices. After these systems create some pictures, the developer can just use

these to create the monster. Back to how strong the art system is. The system made by Jason M. Allen, creates an AI system that forms an art piece by some word descriptions, and it is creating a big number of pictures, Allen saw that Mr. Allen draw many sketches, and the system is based on every sketched and formed a picture. As Allen realized, AI can create lots of art and every single one of the art pieces is different. Therefore, it shows that the AI system can give out many ideas.

In the beginning, letting computers understand art is an important step. The first system is called the Scene-Net model [8]. This system mainly just uses two steps for reaching the goal. The first step is to create a dataset. This dataset is contained into ten categories and holds the sketches. The next step is to let the computer read the art piece. The picture will turn into several 193×193 -pixel squares and be put into the Scene-Net model. Having this small size input letting the computer have a clear view of the details of the picture. This model is separated into eight layers. Layers 1-5 is a part and the rest of the three is another. As depicted in Fig. 2, layers 1-5 is convolutional layers. This kind of layer is gathering higher-dimension messages [9]. Layers 6-8 is fully-connected layers that gather all the data to classify and summarize. By passing the sketch into this model, the computer will know and learn human art. Although this system is based on the sketch, some days in the future, it could be used in painting and 3D modeling to understand what kind of art should be created in a different environment.

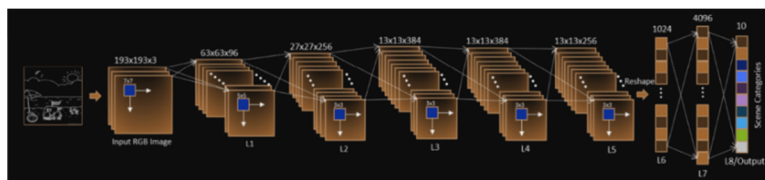


Fig 2. The way that Scene-Net model operate

Another system is called Paper Dream [8]. This is creating drawings based on what people draw on the board. Normally, human interaction and system reactions work together. As shown in Fig. 3, this model is shown how Paper Dream works. Users can just sketch, text, and even use voice to show their idea. Afterwards, the user can just press Inspiration Button for letting the computer create the picture for the user. After pressing the button, the system will start to scan and provide the ideal list which is relative to the thing that the user just draws. Subsequently, the system starts to create those pictures. The user's picture will send by Flask which is built up by python to ajax and wait for a request. At this point, the Gan system comes out. Gan system is a system that will find out the place where the whole system is weak and train again and again [10]. Gan system will read and use the tools which are inside the system and start creating. By using this system, it will be more efficient. Besides, it can create new concepts depending on the input which is the user's picture, and output something new. Whatever the AI drawing or AI level designer, under machine learning this big concept, they all can make something out of people's minds. They all are helping corporate and opening designers' ideas or making something new out. With, further development these systems will be used in other places and bring up technologies.

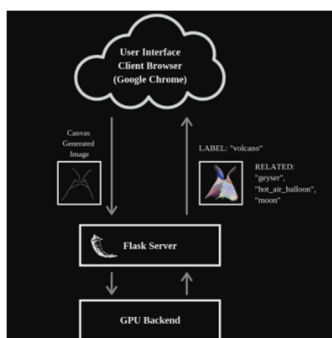


Fig 3. The working process of Paper Dream

4. Limitations & Prospects

These systems are having some big restrictions. They cannot create something complex, similar to what combines modeling and rule which create an NPC or a monster that has its thinking in the game. They cannot make these characters a player. Therefore, it loses a lot of possibilities for making the game more fun. Additionally, these systems are not stable. When there is something new created, it could be weird, and the level of the model could be a mess. Therefore, it becomes a big hinder to the future development of these systems.

Although right now it has many restrictions for AI to learn how to create a game item which is under the game balance and game rules, also designed without any bugs, as time goes it will be created out. With the rise of technology and the rise of computer programs, there will be more and more problems will be solved. The more experiment that does on this idea, the closer distance to success that will be reached. Based on this idea, it also can be helping to create artificial intelligence because this whole big idea is letting the computer design game items for the player which foreshadows it has its thoughts. Therefore, when connecting this idea to an AI robot, one can see there is connection. Hence, it can help scientists to figure out how to give a computer its thought. In addition, not only AIs, even for constructions, it can give out some idea which is humans never think about. Therefore, it not only can bring a big advance to games, but it also brings a big benefit to the whole society. When seeing at the history of machine learning, one finds that machine learning is been developed in every different field. Although there are limitations to let developers cannot reach their goals, it still cannot stop their steps toward reaching success chasing that goal. In the future, there could be more and more systems that will help the designer to develop more games. These machine learning systems will create some real AI NPC by having individual m3D models, characteristics, and behaviors. Hence, those games which are like the anime Sword Art Online could be created.

5. Conclusion

In summary, this paper investigates game design based on machine learning. Specifically, machine learning plays a big role in game design. Not only from According to the analysis but game designing systems only can make some simple basic game work. However, all these systems are working by themselves and creating products. In addition, the rise of these systems is making the game industry to a new level. With the adding of machine learning, there will be more and more new ideas come out and there will be a big jump in AI development. Nevertheless, the restriction on the current state of technology cannot form a machine learning system to form an AI. Moreover, these productions are simple and basic. In the future, these systems can help the designer to create some new kinds of level out, also it can create some NPC who are having its thinking and behaviors. Therefore, the game is getting more elements for making the game more interesting. Meanwhile, these systems can help more AI development. Overall, these results offer a guideline for giving a game character a real personality and free actions.

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