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GAME AI FLAGSHIPS

Аннотация. Спустя более десяти лет после первого исследования по использованию искусственного интеллекта (ИИ) в компьютерных играх и создания новой сферы науки под названием ИИ, термин «видеоигровой ИИ» нуждается в обновлении. Традиционно, задачи, связанные с видеоигровым ИИ, вращались вокруг поведения неигровых персонажей (non-player characters - NPC), начиная от навигации и поиска путей заканчивая принятием решений. Все те коммерческие видеоигры, разработанные за последние 15 лет, и текущие видеоигровые разработки позволяют предположить, что традиционные проблемы видеоигрового ИИ были должным образом решены с использованием сложных подходов к ИИ, которые необязательно вытекают из достижений академиков. Разрыв между индустрией и академиками обусловлен тем, что академический подход к разработке ИИ не в состоянии предложить индустрии методы, способные значительно улучшить существующий процесс проектирования или предоставить масштабируемые решения реальных проблем. Однако в последнее время наблюдается смещение направления в исследованиях. Некоторые из этих альтернативных вариантов использования ИИ уже показали значительный потенциал для использования в коммерческих проектах. В этой статье представлены три ключевых направления исследований видеоигрового ИИ, которые в настоящее время изменяют область исследований, связанной с видеоигровым ИИ.

Ключевые слова: Видеоигровой искусственный интеллект, моделирование опыта игрока, процедурная генерация игрового контента, добыча (дата-майнинг) игровых данных.

Abstract. More than ten years after the first research in the use of artificial intelligence (AI) in computer games and the creation of the new field called AI, the term “gaming AI” needs to be redefined. Traditionally, tasks related to game AI revolved around the behavior of a non-player character (NPC) at different levels of control, from navigation and path finding to decision-making. Commercial standard games developed over the past 15 years and current gaming developments suggest that the traditional problems of gaming AI have been well resolved using sophisticated AI approaches that are not necessarily followed or inspired by academic advances. The existence of the gap between industry and academics is due to the fact that the academic approach to AI development is not able to offer industry methods that can significantly improve the existing design process or provide scalable solutions to real problems. Recently, however, a shift in research has appeared. Some of these alternative uses for AI have already shown significant potential for use in commercial projects. This article presents three key areas of research for gaming AI that are currently reshaping the game AI field.

Keywords: Gaming artificial intelligence, player experience modeling, procedural content generation, game data mining.

Ever since the beginning of the game industry, academics from the AI field were criticizing the game industry for not using new…

Although it is true that the industry continues to use techniques from other three decades ago, the gaming industry does not shy away from making small but important steps to integrate modern AI into its games. Due to the emergence of reliable and effective solutions for gaming AI, a more frequent and constructive relationship with the industry has appeared. In recent years, there has been a shift in academic interests in regarding gaming AI. We reached an era when focus started to shift away from NPCs AI. Instead, the focus of attention began to shift toward the interweaving of game design and gaming technology by considering the role of AI in general: AI can help us create better games, but this does not only mean creating NPCs that are more believable. There are a number of key research areas that have recently provided innovative and commercially plausible solutions to a number of game development challenges. In this paper, three of those will be presented: Player experience modeling (PEM), Procedural content generation (PCG) and Large-scale analysis of players' data.

Player experience modeling. In recent years, there has been an increase in size of the gaming population and demographic diversification of computer game players. This means that skills, preferences and experience can greatly vary between players of the same game. Therefore, the need to adapt games to individual gaming experience is growing, and the challenges of user modeling and adaptation based on experience in games are becoming increasingly important and complex. Player Experience Modeling (PEM) is the study and use of artificial intelligence techniques for completing those tasks. We can distinguish three main types of approaches for modeling the player's experience in games, which are based on data expressed by players (subjective PEM); player data obtained from alternative player responses (objective PEM); and data obtained from the player-game interactions (gameplay-based PEM).

The most direct way to develop an experience model is to directly ask the players about their gaming experience and build a model based on data expressed. Subjective PEM considers first-person reports. Subjective modeling of the player's experience can be based on player's responses during the act of playing the game, data obtained using questionnaires or self-reports. While self-reports have their own inherent limitations, including user self-deception and memory dependency, numerous studies have shown that self-reports can successfully guide machine learning algorithms to reflect aspects of a player's experience in platformer and racing games.

The player's experience can be associated with streams of emotions, which can be active at the same time. They are usually caused by the events occurring during the game. Games can cause player to express emotions, which, in turn, can affect the physiology of the player, reflect on the facial expression, pose and speech of the player. Monitoring such bodily changes may help us recognize player's emotional responses. Models constructed using the objective PEM approach can be very accurate representations of the player's experience, since the experience is seen holistically through usage of several input methods. Key limitations of the objective PEM approach include its high intrusiveness and questionable feasibility.

The main assumption about gameplay-based PEM is that the player's actions and real-time preferences are related to the player's experience since games can influence the player's processing patterns and their focus. For the same reason, cognitive processes can affect emotions, since the player's emotional state can be understood by analyzing interaction patterns and associating user emotions with context variables. Any element derived from the interaction between the player and the game forms the basis for gameplay-based PEM. The input data for this type of player's experience model is usually correlated with such conditions, as attention, challenge, and engagement. Moreover, several different measures of complexity were proposed for different game genres such as real-time strategies (RTS) and board games. Sometimes player experience models can be formed by data-mining.

Gameplay-based PEM is perhaps the most computationally efficient and least intrusive PEM approach, but usually leads to a low-resolution player experience model.

Procedural content generation. Procedural content generation (PCG) can be viewed as the research and development of algorithms that generate game content automatically. Game content refers to all customizable game elements that may affect a player's experience, which may include maps, levels, stories, quests, rule sets, camera positions, and music. Procedural content generation in games provides several advantages. Firstly, PCG can ease the enormous efforts and lower the costs of creating content, as well as simplify changing of content for the player needs. Secondly, the content of the game can automatically adapt to the needs and preferences of individual players and ensure maximum replayability. Thirdly, PCG can challenge the creative potential of a human and generate solutions that go beyond the imagination of the game designer.

The research efforts of combining PEM and PCG have led to research projects with high commercial potential within the framework of experience-based procedural content generation (EPCG). According to the EPCG structure, content is considered as a building block of the player's experience, which can be customized to optimize said player's experience.

AI game data mining. Game data mining can be broadly defined as using AI (data mining algorithms) to answer such questions as: how do people play a game?; is the game played as expected?; why do people stop playing a game?; why do we play a game the way we do?; can we predict what a player will do? These and many more similar questions are all important and related to user-oriented testing procedures used in the gaming industry. In iteratively phased game development, representative samples of the target audience, as well as internal professional testers, spend time and make efforts to test games and assess the quality of the gameplay. For the past five years, as an alternative to traditional testing, key game developers have been collecting and analyzing detailed and large-scale behavioral data of

players through specialized monitoring software. According to Big Data analysts, we have reached a point where existing data mining algorithms cannot track the increasing amount of available data sets, and therefore cannot fully support the analysis of such data. This creates exciting new challenges and opportunities for the study of AI in games, since the use of AI to determine game models based on collected players' data can provide a quantitative approach and complement traditional quality approaches for testing users and playability.

Conclusion. More than ten years after the creation of the game AI field, this term needs to be revisited and expanded upon using non-traditional areas of research and development. The abundance of ways to use artificial intelligence in games today, in addition to traditional areas such as NPC AI, demonstrates the potential of the research field and can expand the boundaries of design in these creative industries.

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