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The Role of AI and Games Towards

Discovering Fairness

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Abstract

Game playing is widely regarded as a mentally stimulating activity. It has long served as not only entertainment but also test beds and benchmarks for artificial intelligence. Major milestones in the development of computer programs capable of playing chess over the last 60 years, to some extent, lead to the major development history of artificial intelligence (AI). In the transition from traditional games to games with AI players, it is hard to keep fairness when AI becomes stronger than human experts. Fairness stems from a respect for local goals and a desire to learn what the rules of the game are for them in that setting from individuals at different levels. In different cultures, fairness presents an interesting problem because local perceptions of fairness vary and every civilization has distinct ideas about what is fair and what is unfair. Fairness in games affects not only how a game is played, but also how the game is experienced. Previous works have interpreted the importance of fairness, called advantage of initiative (AoI), which had been previously discussed and proved through a conclusive and elegant theorem on first-player wins over second-player wins, but there have been no clear links among those interpretations. Observing the effect of the advantage of initiative in the game leads to addressing the challenge of not only keeping fairness but also maintaining the balance between competitiveness and entertainment. Inspired by classical physics, the motion in mind model was developed and adopted to better define the user experience in game-playing, where its relations in the social context were investigated from the historical development of games. The Gini coefficient g is an indicator used to quantify unfairness in n -person cooperative games (i.e., economics in society). In this thesis, the measurements of fairness and comfort, which are derived from the motion in mind concept and Gini coefficient, were used to analyze how the evolutionary trends of different games are changed to maintain the fairness and various elements of games. This thesis focuses on understanding the advantage of initiative along with its impact on game outcome and exploring the concept of play

comfort, social comfort, and their culture with consideration of fairness. To achieve it, we are guided by three purposes: (1) To characterize the advantage of initiative and its impact on the evolution of game rules and game outcome, and (2) To define the gamified experience and notion of fairness (3) To develop the fairness measurement that indicates the balance between competitiveness and entertainment and establish the link between play, culture, and society. Using the motion in mind model as a measurement of fairness and comfort based on the 2-person game contexts demonstrates that it can show the link between play comfort and play culture. Furthermore, the measurement is expanded into n-person cooperative games that show social comfort which is related to play culture. For comparison, fairness indicators in n-person games with a focus on the Gini coefficient in economics were adopted in which similarities were found, prompting the revisiting of Huizinga's Homo Ludens that identify a link between play, culture, and society decades prior. In both competitive two-person games and society, it was found that the trend of unfairness was reduced, while some enhancements to maintain fairness in classical board games and economics were discussed.

Keywords: fairness, game progress pattern, motion in mind, Gini coefficient, economy