AI Education Matters: 2022 EAAI Mentored Undergraduate Research Challenge: AI-Assisted Game Design

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Introduction

In this column, we introduce the next AAAI/EAAI-2022 mentored undergraduate research challenge: AI-Assisted Game Design (AIAGD). We survey a number of AIAGD applications, provide references, and make suggestions for undergraduates to engage in this open-ended, creative research challenge.

AI-Assisted Game Design

There is a very large body of research on AI game playing agents dating back to the foundations of Artificial Intelligence (Russell & Norvig, 2020, p. 175–179). What distinguishes AIAGD from AI game play is that the results of an AI technique are applied to the design of the game itself. This can take on many forms and employ a wide variety of algorithms beyond game-tree search. Most commonly, researchers use the term to describe procedurally generated content (e.g. maps, levels) in games (Shaker, Togelius, & Nelson, 2016). However, we envision (along with others) a future of game development where AI largely takes the place of human playtesters, and suggests refinements and innovations in design.

Game Analysis for Game Improvement

Let us first motivate the benefit of AI-assistance through some common examples. Magic: The Gathering (MTG), the first trading card game, has enjoyed great commercial success since its release in 1993. Different formats of play involve different subsets of card set releases. For instance, standard format allows play of the last 1-2 years of sets. Each set is playtested by Wizards of the Coast R&D, yet in recent years there has been significant underestimation of the power of cards to "warp" the format metagame, i.e. pressure players to play fewer, similar deck types in order to be competitive. Since 2018, a record 20 cards have been banned from play in the standard format.

While some blame recent card bans on the speed with which players "solve" optimal deck construction with unprecedented online play data and analytics, one might also argue that a relatively small group of playtesters under time constraints cannot possibly anticipate all consequences of card synergies or hope to balance a format before its release. One might envision AI-assisted set design in the future that would anticipate problematic card designs and balance a set to allow diverse, viable deck types for competition, what is called a "healthy metagame".

MTG is not alone in this regard. One that is familiar with most any commercial card game can often provide examples of cards that are "over-powered" (OP), e.g. the Guild Hall card of San Juan or the Mistress of Ceremonies card in St. Petersburg, as well as underpowered cards one never wants to play. Ideally, every component and every mechanic of a game should have some reasonable use for being part of the design beyond challenging the player to discern their uselessness.

This is not limited to card games. Players of fighting video games are used to frequent patches that "nerf"/"buff", i.e. make weaker/stronger, weapons that are too strong/weak, respectively. For example, in Fortnite's July 2020 patch, the Tactical Submachine Gun (SMG) was buffed, and the Compact SMG was nerfed. Modern video game designers find themselves continually developing games, mining play data for hints of better parameter settings.

However, it would be too much to expect undergraduate researchers to make a significant contribution to AIAGD of the most complex games, so we recommend entry-level research on very simple games or puzzles (i.e. solitaire games). For example, the card game "Fowl Play" is a jeopardy card game based on

the folk dice game "Pig". In (Neller, Malec, Presser, & Jacobs, 2014), the computation of optimal play was used to seek out optimal komi (i.e. points awarded to the disadvantaged player to make the game more fair), and ultimately to redesign the distribution of cards and komi so as to very closely approximate a fair game.

AI-Assisted Game Invention

There are also research efforts to use AI to search subspaces of game design in order to create new games. The work of Cameron Browne with his Digital Ludeme Project seeks to express a wide variety of historical games according to game units called "ludemes". Browne used an evolutionary algorithmic approach to computationally design the game Yavalath (Browne, 2011, pp. 75-85). One can find interesting examples of the intersection of AI and game design in Browne's Game and Puzzle Design Journal.

As a simpler example, the solitaire card game "Birds of a Feather" (Neller, 2016), was AI-assisted in design in that statistics from an AI solver showed that (1) the "adjacent rank" portion of the movement rules brought better balance to movement types, and (2) the 4×4 tableau of cards was a sweet spot for balancing the level of puzzle challenge with a high probability of solvability given a random deal. Additionally, an AI solver helped reveal gameplay quality characteristics of deals designed to be challenging. (Neller & Ziegler, 2019)

What is the Utility?

While it is easy to see that AI techniques can aid us in optimizing design, it is important to critically think about what we are seeking to optimize. Whereas much of the work cited above concerns itself to optimal play in the sense of maximizing the probability of winning, the entertainment industry seeks to optimize game play experience, e.g. player engagement. In conversation, a video game designer explained, "We don't want an AI [player] that plays optimally, we want an AI that will create a close game that will draw the [human] player into their best play ... and then barely lose to that [human] player. That is the most satisfying experience."

So there is another sense in which AI assists in game design through adaptively shaping the quality of a player's experience. Entertainment and engagement are the watchwords of this locus of work.

Mentored Undergraduate Research Challenge

The AAAI/EAAI-2022 Mentored Undergraduate Research Challenge is to submit a paper that describes a creative application of AI technique(s) to the design of a game or puzzle. As mentioned, this can take many forms, including but not limited to:

- Existing game improvement through AI game analysis,
- New game design through AI search in a design space,
- Adaptive technologies shown empirically to improve player experience, and
- AI procedural generation of game play elements.

A team must consist of at least one faculty mentor and at least one undergraduate researcher. The mentor will be expected to guide the research and full paper writing to be submitted to EAAI-2022, and will serve as a reviewer for up to 4 other paper submissions. We recommend that the student read from sources in the most interesting locus of work described above, and *pursue simple games and simple aims first*. If you enjoy games and puzzles, enjoy the ambitious and diverse body of AI techniques, and would like to bring these together in creative expression, please form a team and contact the author of this columns with team member names, email addresses, and roles (e.g. mentor, undergraduate).

Graduate students are permitted to join teams, as long as at least one undergraduate is an active participant. Team sizes and the number of teams from an institution are not limited. However, the number of accepted papers will be limited, with peer review focused on quality of writing, evidence of creativity, and relevance to AI-assisted game design.

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