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Back to the Past: Ancient Games as a New AI Frontier

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Abstract

This short note proposes the study of ancient games as a new frontier for game AI research. This aspect of games research has been largely neglected so far from an AI perspective, but could benefit significantly from the application of modern computational techniques.

While other AI researchers tackle increasingly complex games and explore new modes of play that lie ahead, I wish to go in the other direction: back to the simpler games of our ancestors and the origins of play. The development of games goes hand-in-hand with the development of culture (Huizinga 1950) and games provide a window of insight onto our cultural past. However, there are still large gaps in our knowledge of the history of early games, which I believe modern AI techniques can help to clarify.

The Evolution of Games

The focus here is on *traditional games of strategy*, i.e. games with no known author or proprietary owner (Parlett 1999, p.5) in which players succeed through mental rather than physical acumen. This includes board games, card games, dice games, tile games, and so on.

Actual evidence of early games is scarce; they appear to have been taught largely through oral tradition, and perhaps not seen as important enough to record meticulously. This appears to have facilitated their mutation and improvement into the variety that we see today (Murray 1952), but means that the transcription of complete rule sets and equipment was not common until recent centuries. Computationally modelling a "family tree" of traditional games could help shed light on those gaps in our knowledge of early games.

Computational Phylogenetics

Computational phylogenetics provides a potential mechanism for charting the evolution of traditional games. The basic model used to create phylogenetic trees mapping the dispersal of human language (Greenhill 2015) appears suitable for this task, although care must be taken to avoid false analogies between anthropological and biological models (Morrison 2013), as phylogenetic approaches were developed for biological domains. Specifically, the *genotype* of artefacts needs to be clearly distinguished from their *phenotype*. List et al. (2016) provide guidelines for correctly casting cultural domains in a biological framework.

Morrison (2014) points out that phylogenetic *networks* may be more suitable than phylogenetic *trees* for modelling the evolution of cultural artefacts. This seems especially relevant for formal games, which are more likely to have evolved through distributed *polygenesis* rather than *monogenesis* from a single common ancestor (Parlett 2011), and highly subject to the equivalent of horizontal gene transfer.

Ludemes

The decomposition of games into their component *ludemes*, i.e. conceptual units of game-related information, allows us to distinguish between a game's *form* (its rules and equipment) and its *function* (its emergent behaviour through play). This separation provides a clear genotype/phenotype analogy that makes phylogenetic analysis possible, with ludemes making up the "DNA" that defines each game.

This ludemic model of games was successfully demonstrated in earlier work to evolve new board games from existing ones (Browne 2011). Recent work shows how this model can be enhanced for greater generality and extensibility, to allow the definition of almost any ludeme that can be computationally modelled (Browne 2016).

This approach provides the potential for a single AI software tool able to model, play and analyse almost any traditional game of strategy as a structure of ludemes. It also provides a mechanism for identifying underlying mathematical correspondences between games, to establish probabilistic (if not causal) relationships between them, in lieu of an actual genetic heritage. Note that the total number of ludemes will be an order of magnitude smaller than the total number of games.

Digital Archæoludology

With these ideas in mind, I propose a new field of study called *digital archæoludology*, for the analysis and reconstruction of ancient games from incomplete descriptions using modern computational techniques. The aim is to provide tools and methods that might help game historians and researchers better understand traditional games.

Finkel (2007) demonstrates the lengths that game researchers have gone to, in his extraordinary reconstruction of the Royal Game of Ur from ancient Sumerian tablets (2007), while Ashton's (2010) analysis of the ancient Viking game Hnefatafl suggests that careless interpretations of ancient texts can produce errors that propagate through even the most respected sources (Murray 1952). Interpretation also affects the use of games as tools for cultural analysis. This can be seen, for example, in the discovery of similar games in ancient Mexico and India being used as evidence of pre-Columbian contact between Asia and South America (Tyler 1875), a claim disputed half a century later due to the notion of "limited possibilities" in design (Erasmus 1950).

Digital archæoludology could shed light on such cases, by revealing through mathematical analysis whether reconstructed rule sets might be flawed, how they might be improved, and the likelihood of given games occurring from common bases. Modern AI techniques provide the means to estimate both the *quality* of reconstructions (as games) as well as their *authenticity* (as cultural artefacts).

Further, if we can tag ludemes by their underlying mathematical principles, to locate them culturally and historically, we have a mechanism for creating roadmaps that trace the transmission of mathematical ideas across cultures through play. Such analysis could help fill the gaps in our knowledge of the history of games, and raises the intriguing possibility of finding "missing links" that might explain logical gaps in the family tree (or network) of traditional games.

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