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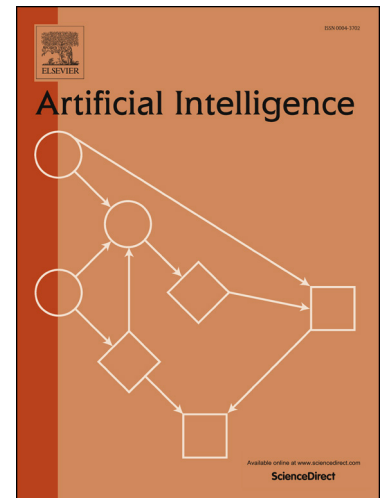
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# Fixing Balanced Knockout and Double Elimination Tournaments

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## Abstract

Balanced knockout tournaments are one of the most common formats for sports competitions, and are also used in elections and decision-making. We consider the computational problem of finding the optimal draw for a particular player in such a tournament. The problem has generated considerable research within AI in recent years. We prove that checking whether there exists a draw in which a player wins is NP-complete, thereby settling an outstanding open problem. Our main result has a number of interesting implications on related counting and approximation problems. We present a memoization-based algorithm for the problem that is faster than previous approaches. Moreover, we highlight two natural cases that can be solved in polynomial time. All of our results also hold for the more general problem of counting the number of draws in which a given player is the winner. Finally, we show that our main NP-completeness result extends to a variant of balanced knockout tournaments called double-elimination tournaments.

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<sup>☆</sup>This is a revised and expanded version of Aziz et al. [3] with additional proof details as well as new results for tournaments with kings and double elimination tournaments.

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