Computing optimal behavioural strategies in 2-person zero-sum sequential games with imperfect information (Get rich, *Or die Tryin'*)

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Abstract

In 1951 (during his thesis!), Nash stated and proved that any finite game admits at least one equilibrium (now known as a *Nash Equilibrium*). An optimal way to play any finite game is thus to compute a NE (s_i, s_{-i}) offline, and then play one's part of the deal s_i online. By construction, one shouldn't do any worst than the *value* of the game. For games with imperfect information like Poker, the problem of effectively computing such Nash equilibria remains a computational challenge (for example, a solution technique using the normal form of the game will scale exponentially with the game size which can be worth billions of nodes for 'simple' games). I'll sketch the *sequence-form representation* which was developed by D. Koller, Benhard von Stengel, and co-workers, in the 90's and illustrate some solution techniques from convex optimization, which are applicable to this representation. As proof of concept, I'll present a simple bot which optimally plays Kuhn's poker.

Index Terms

Game Theory; non-cooperative game; 2-person zero-sum sequential game; imperfect information; Nash equilibrium; behavioural strategy; optimality; normal-form representation; sequence-form representation; convex analysis