Abstract

In practice, agents often act sequentially: they take their decisions one after the other and base their decisions on those that have already been taken. Such sequential behaviour can be modelled in a congestion game by putting an order on the players. Inspired by a playing technique for chess, we introduce a new framework for modelling anticipating players, parametrised by the number of successors an agent anticipates, that has myopic behaviour (no anticipation) and subgame-perfect behaviour (full anticipation) as its extreme points. For various classes of congestion games, we study which amounts of anticipation lead to outcomes that are Nash equilibria ("stability") and/or are guaranteed to be within a certain factor of the optimal outcome with respect to egalitarian or utilitarian social cost ("efficiency").

Surprisingly, more anticipation does not always lead to better outcomes: subgame-perfect behaviour may lead to unstable outcomes for symmetric network congestion games on extension-parallel graphs, whereas myopic behaviour leads to high-quality stable outcomes on all series-parallel graphs. The instability of subgame-perfect outcomes can be resolved on extension-parallel graphs by removing the ties. In that case, full anticipation guarantees the first player the best cost, independent of the number of successors the other players anticipate.

For singleton cost-sharing games, symmetric cost-sharing games and games generalising cut and consensus games it is also the case that the instability of subgame-perfect outcomes can be resolved by removing the ties. For the latter two classes, we moreover encounter a threshold effect: changing the level of anticipation may lead to worse outcomes except when moving to full anticipation. In fact, we only find one class of games for which the efficiency increases non-trivially and monotonically with the anticipation, namely affine symmetric cost-sharing games. The efficiency increases trivially for symmetric singleton congestion games and generic symmetric network congestion games on extension-parallel graphs, for which we prove that any level of anticipation has the set of Nash equilibria as set of outcomes.